Wireless E911: A North Carolina Telecommunicator's Perspective

A resource provided by the North Carolina 911 Board

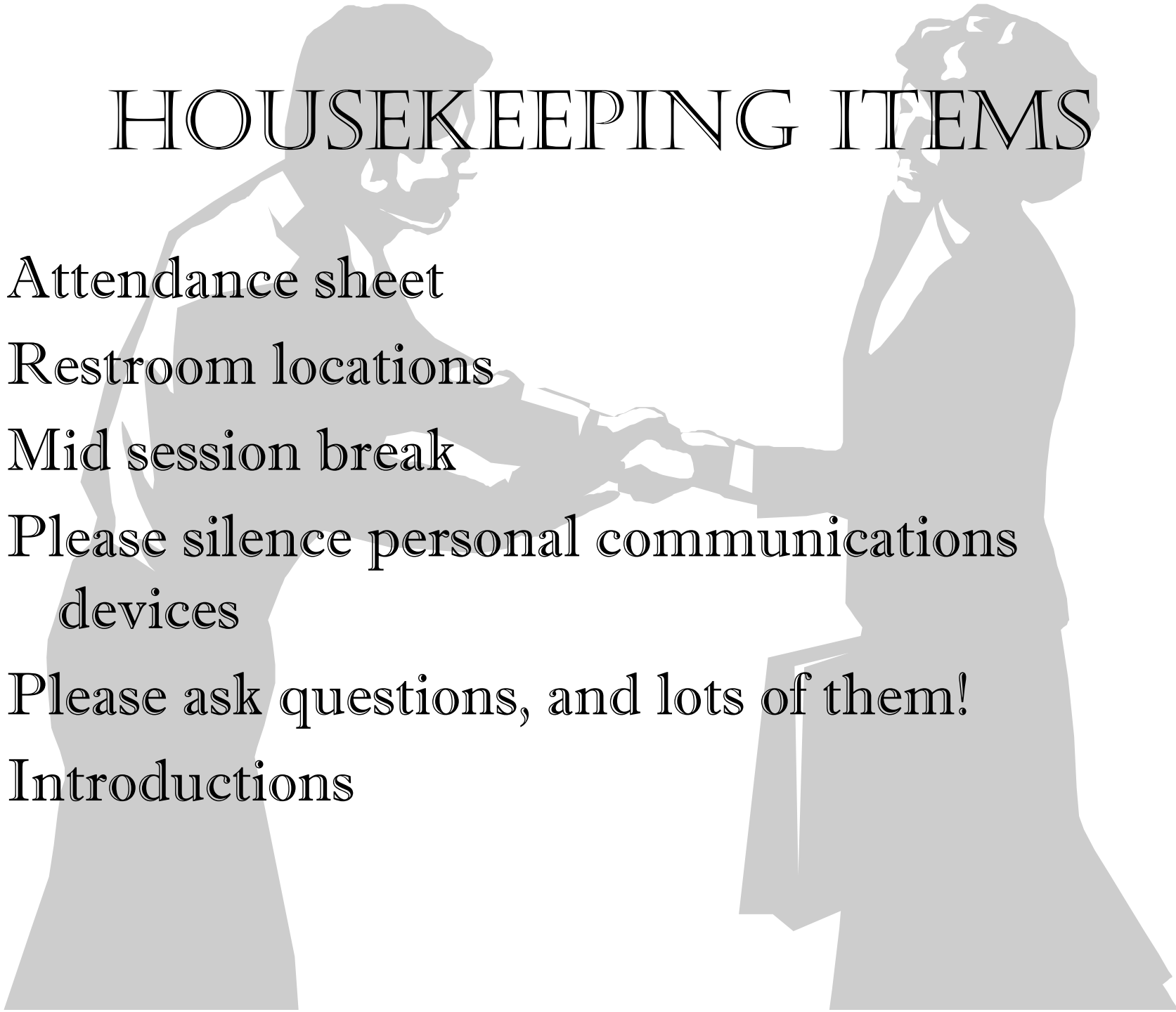
Presented by Ron Adams, ENP

Networking Technician, NC 911 Board

Phone: 919-754-2944

E-mail: ron.adams@its.nc.gov

HOUSEKEEPING ITEMS



- Attendance sheet
- Restroom locations
- Mid session break
- Please silence personal communications devices
- Please ask questions, and lots of them!
- Introductions

PHASE 1 VS PHASE 2

As established in FCC Report and Order 94-102 (issued December 1, 1997):

PHASE 1

Requires wireless service providers to deliver to the *appropriate* PSAP the telephone number of the handset originating the 911 call (callback number), the p-ANI, and the street address of the cell site/sector receiving the 911 call

PHASE 2

Requires wireless service providers to deliver to the *appropriate* PSAP the telephone number of the handset originating the 911 call and the latitude and longitude of the caller

ANI vs p-ANI

ANI stands for Automatic Number Identification. It represents the telephone number in a wireline 911 call

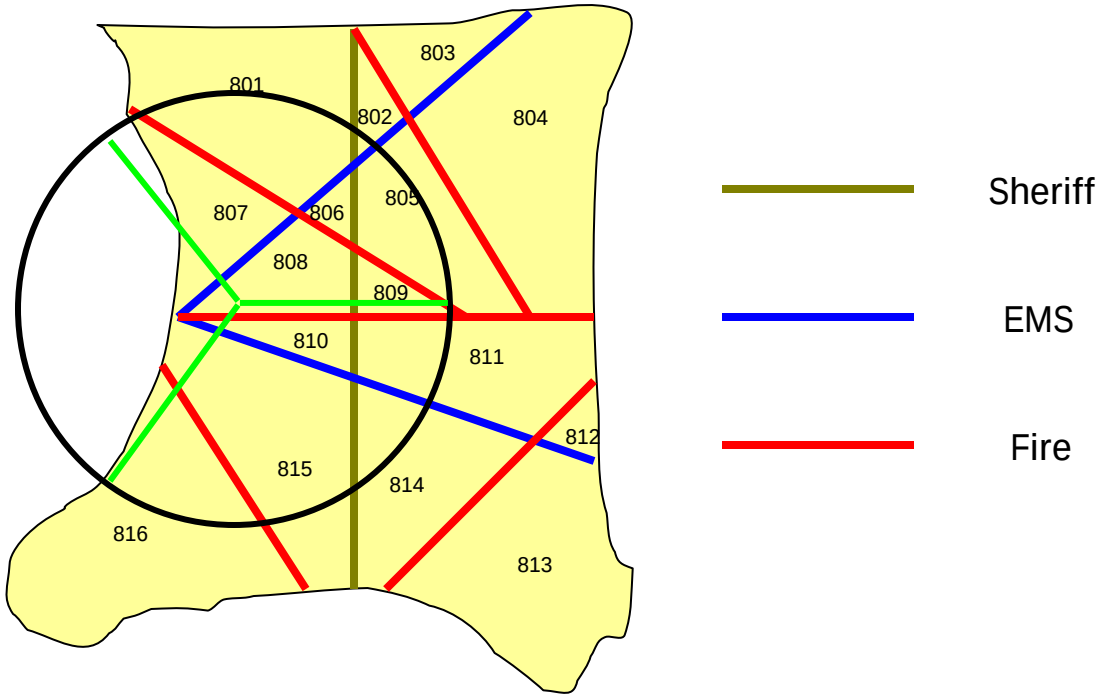
A p-ANI looks like a telephone number (or wireline ANI), but is instead an identification number, and does not connect to any phone

Each ANI and p-ANI is associated with an ESN

A p-ANI may appear on ALI screens in the wireline ANI field, which can be very misleading

ESZs and ESNs

Overlapping service area boundaries require multiple different response scenarios



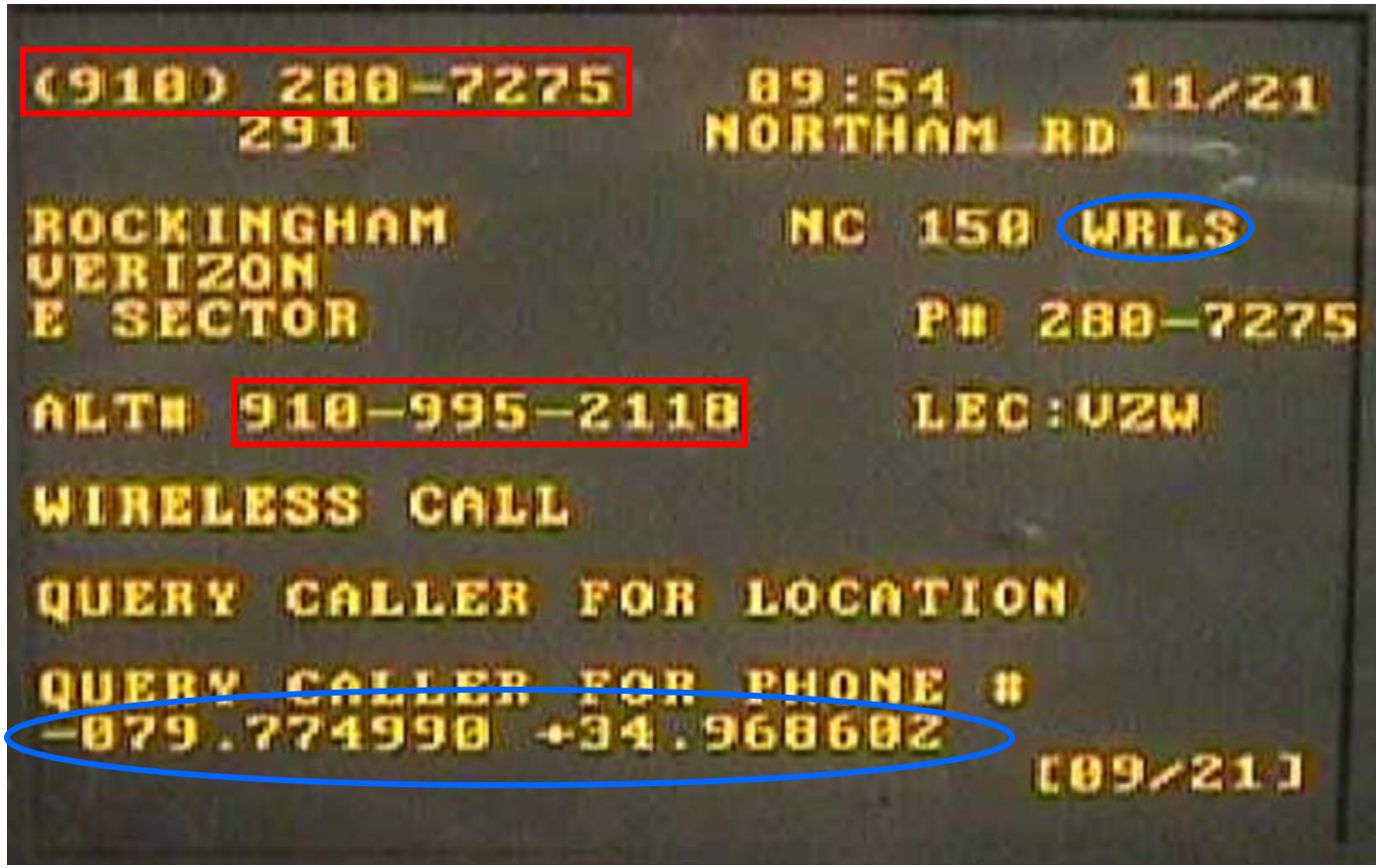
Radio signals cannot be made to conform to man-made artificial boundary lines the way wireline signals can.

NC AT&T LEC ANI/ALI screen sample: Positron IAP

p-ANI

MDN

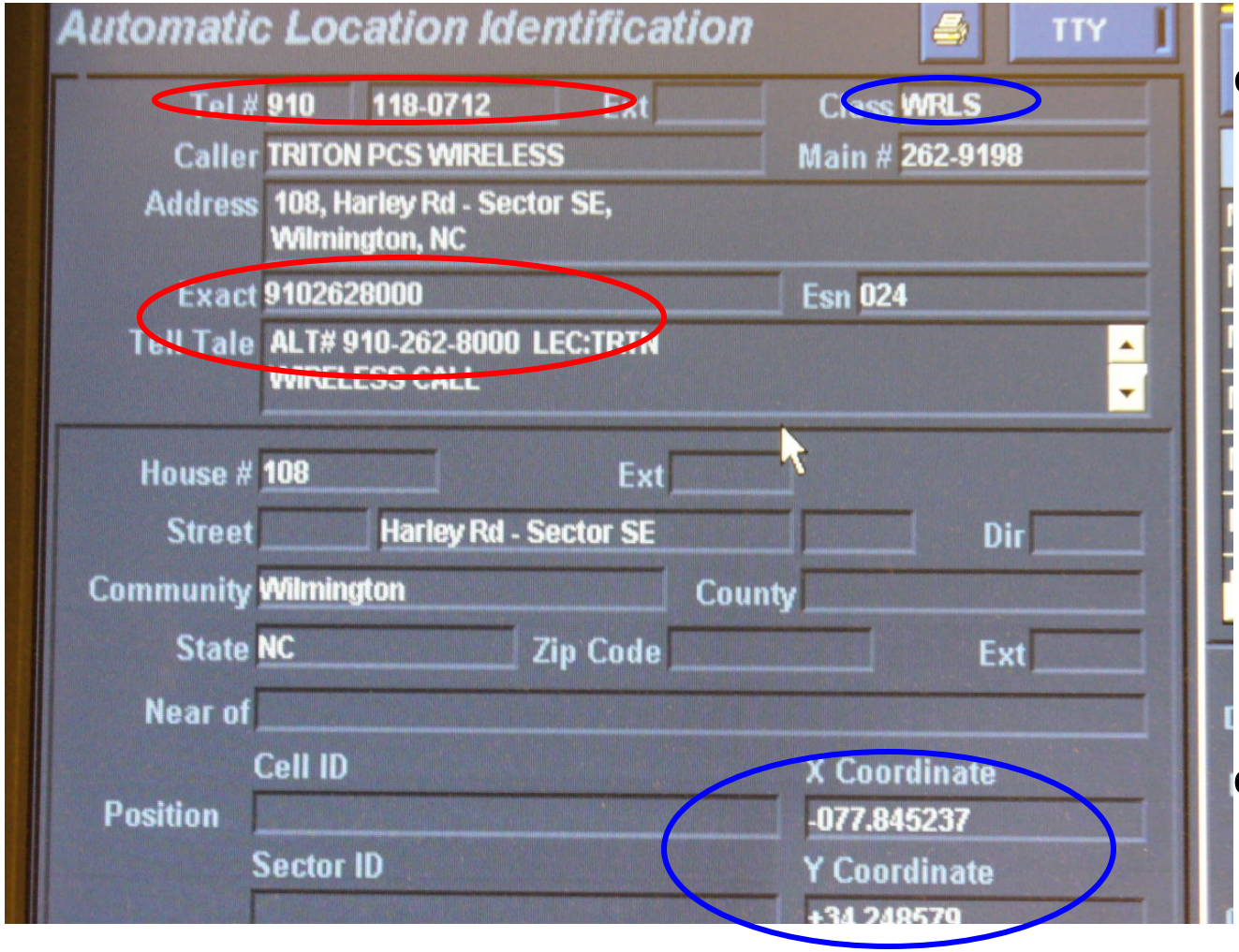
Cell tower or centroid coordinates



NC AT&T LEC ANI/ALI screen sample: Positron Power911

p-ANI

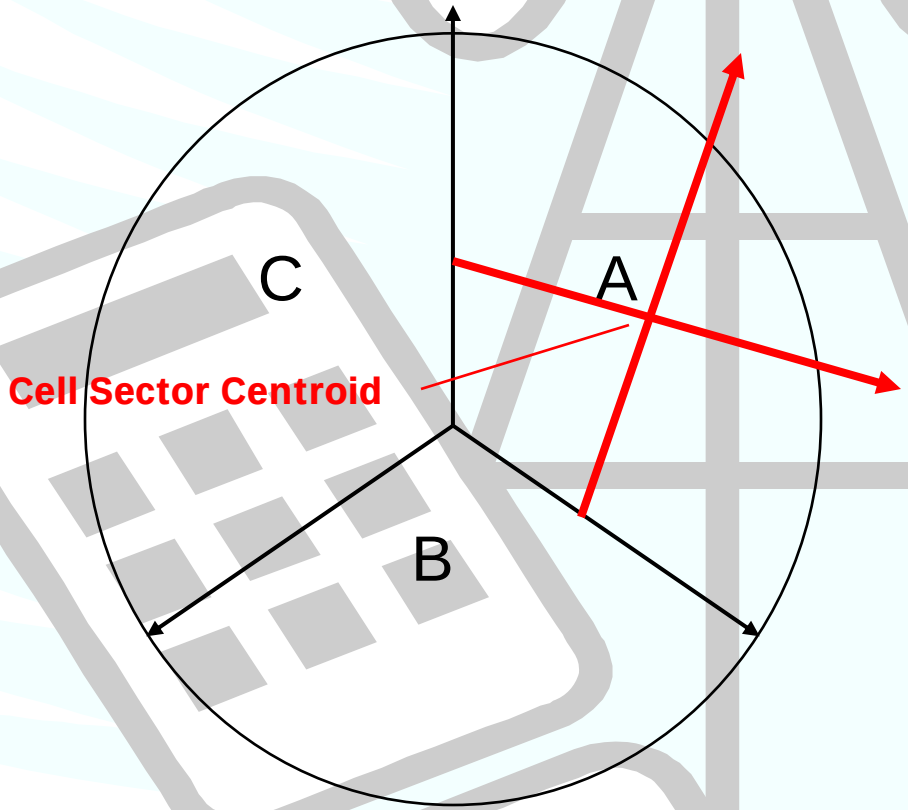
MDN



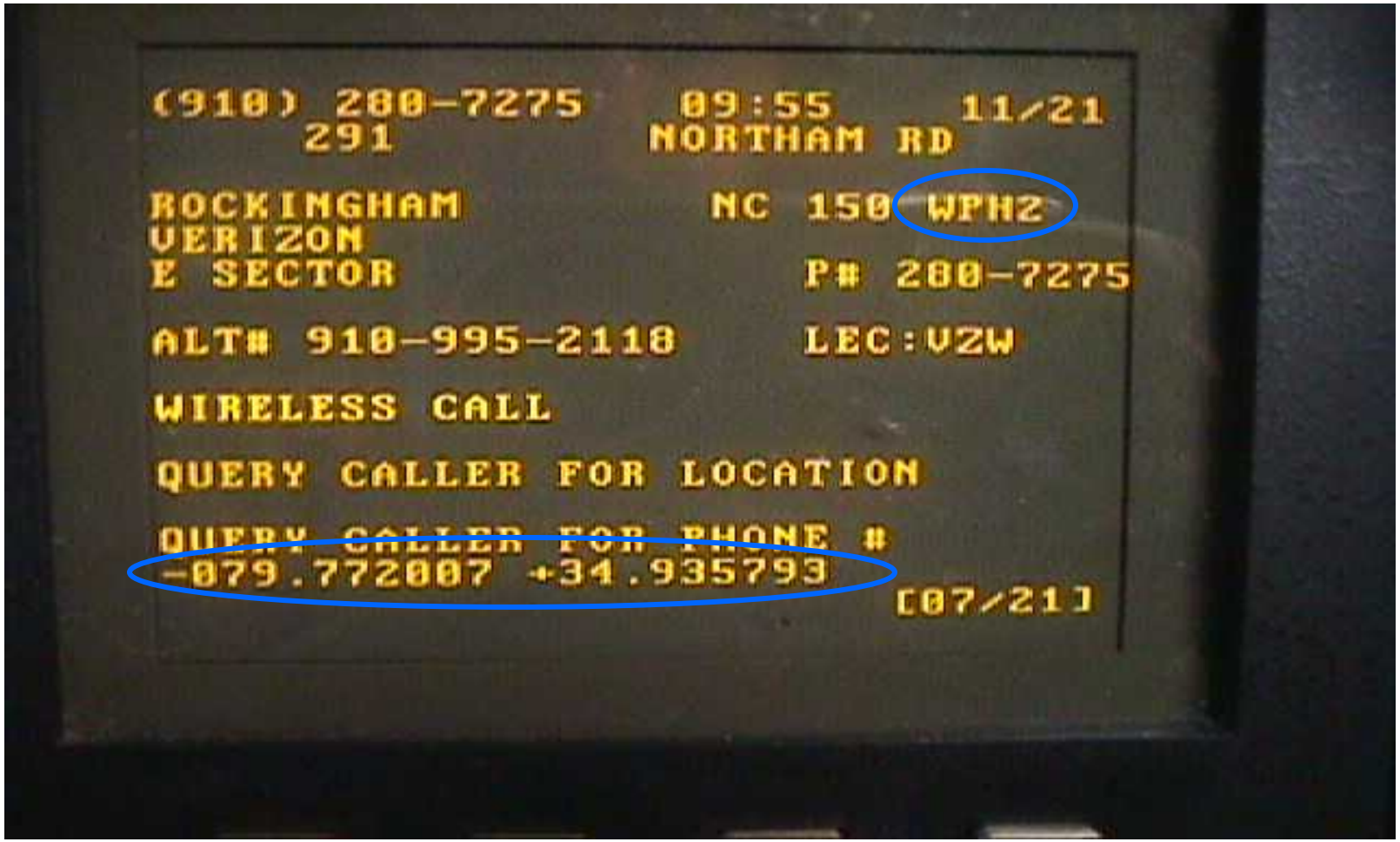
class of service

cell tower or centroid coordinates

CELL CENTROID

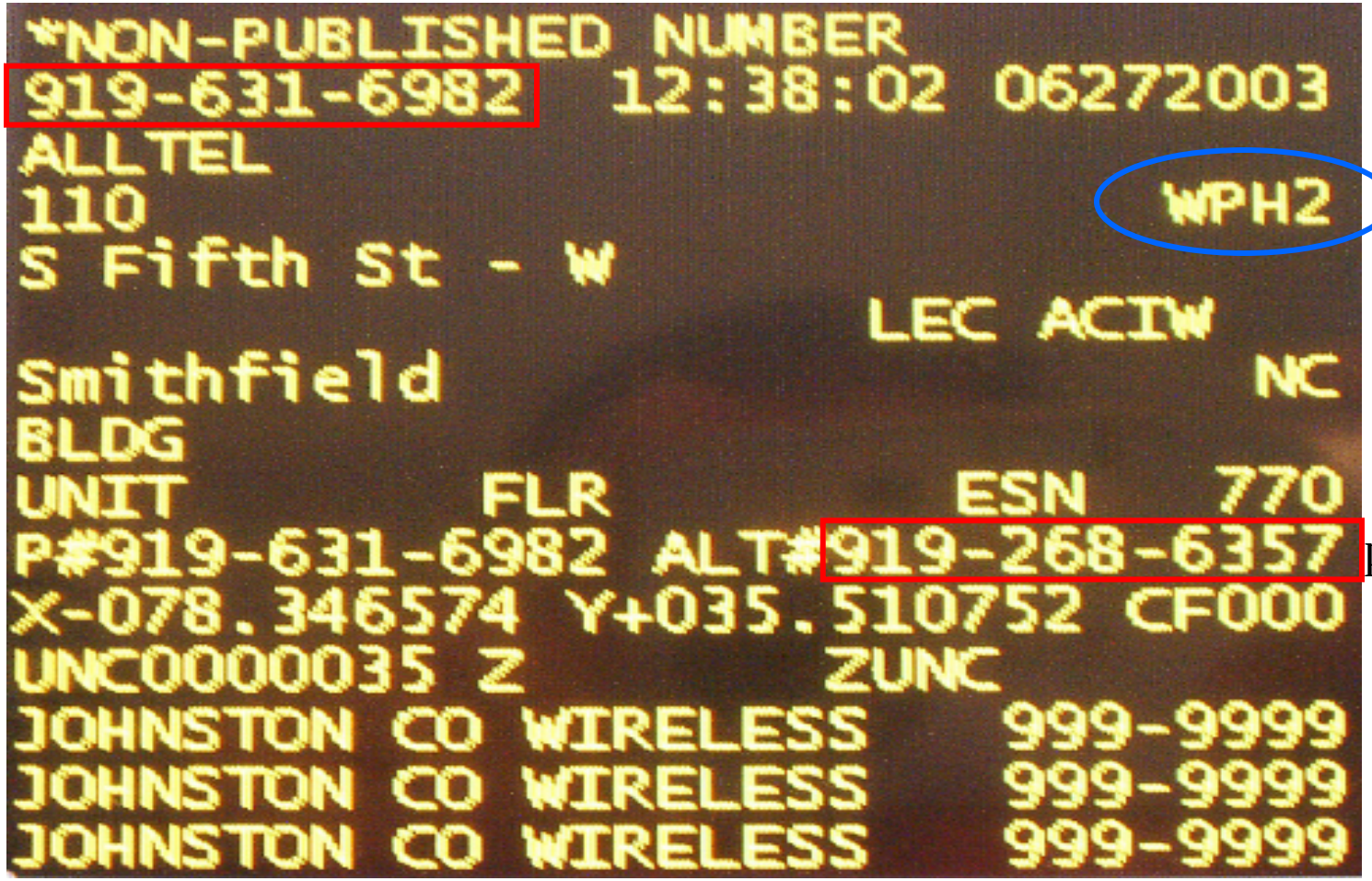


NC AT&T Positron "IAP" (same call, Phase 2 after re-bid)



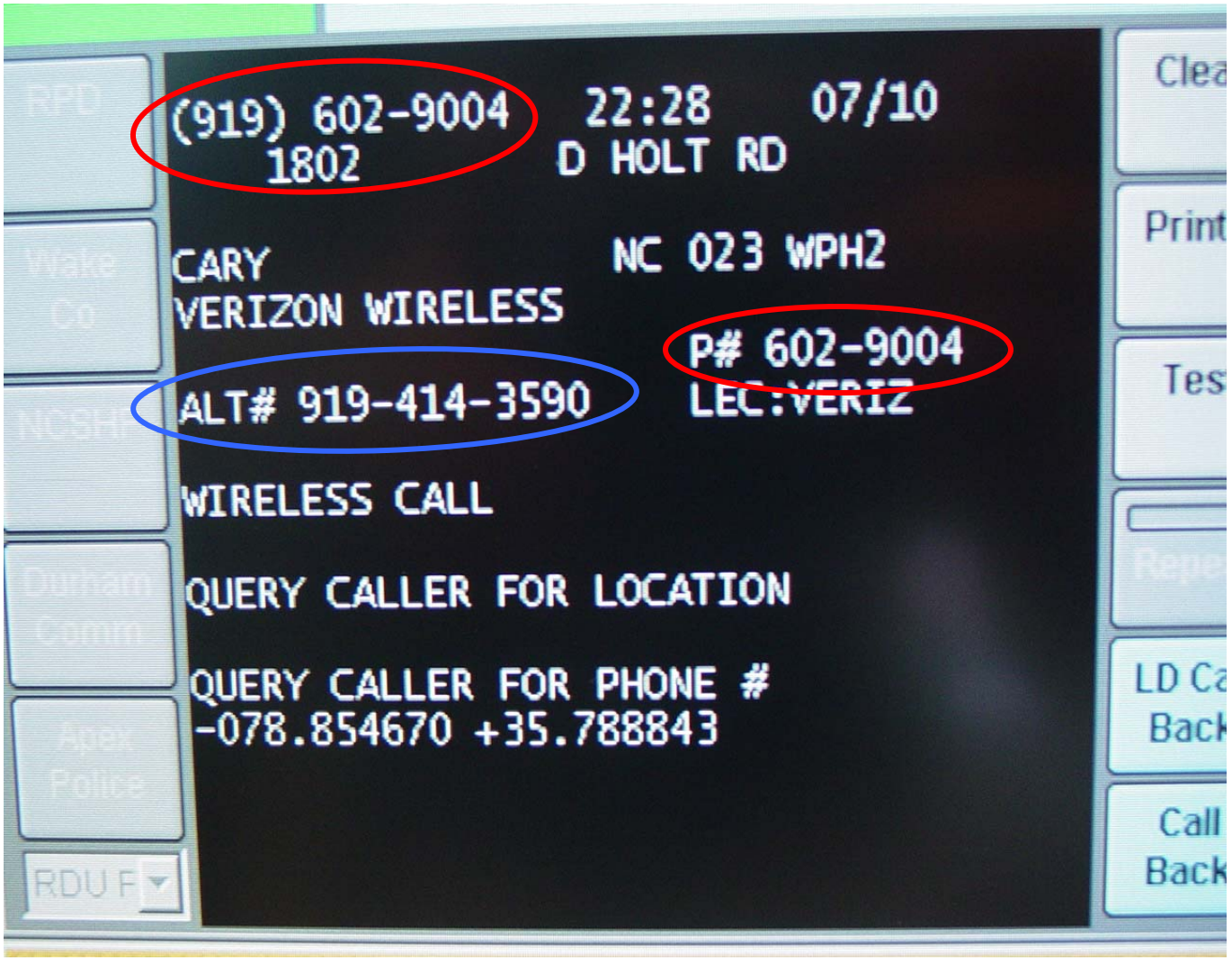
NC Embarq LEC ANI/ALI screen sample: Positron Simon

MDN

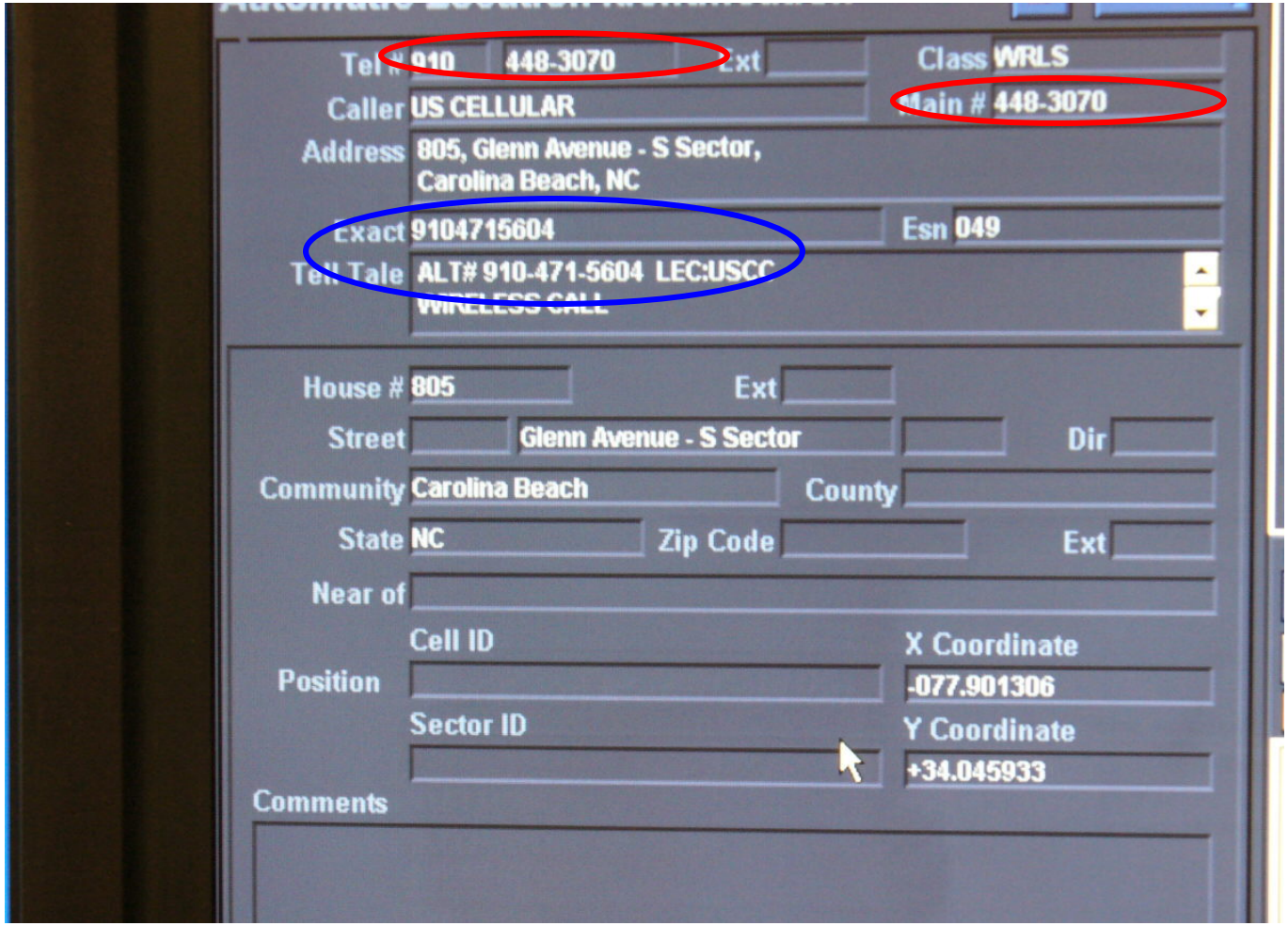


p-ANI

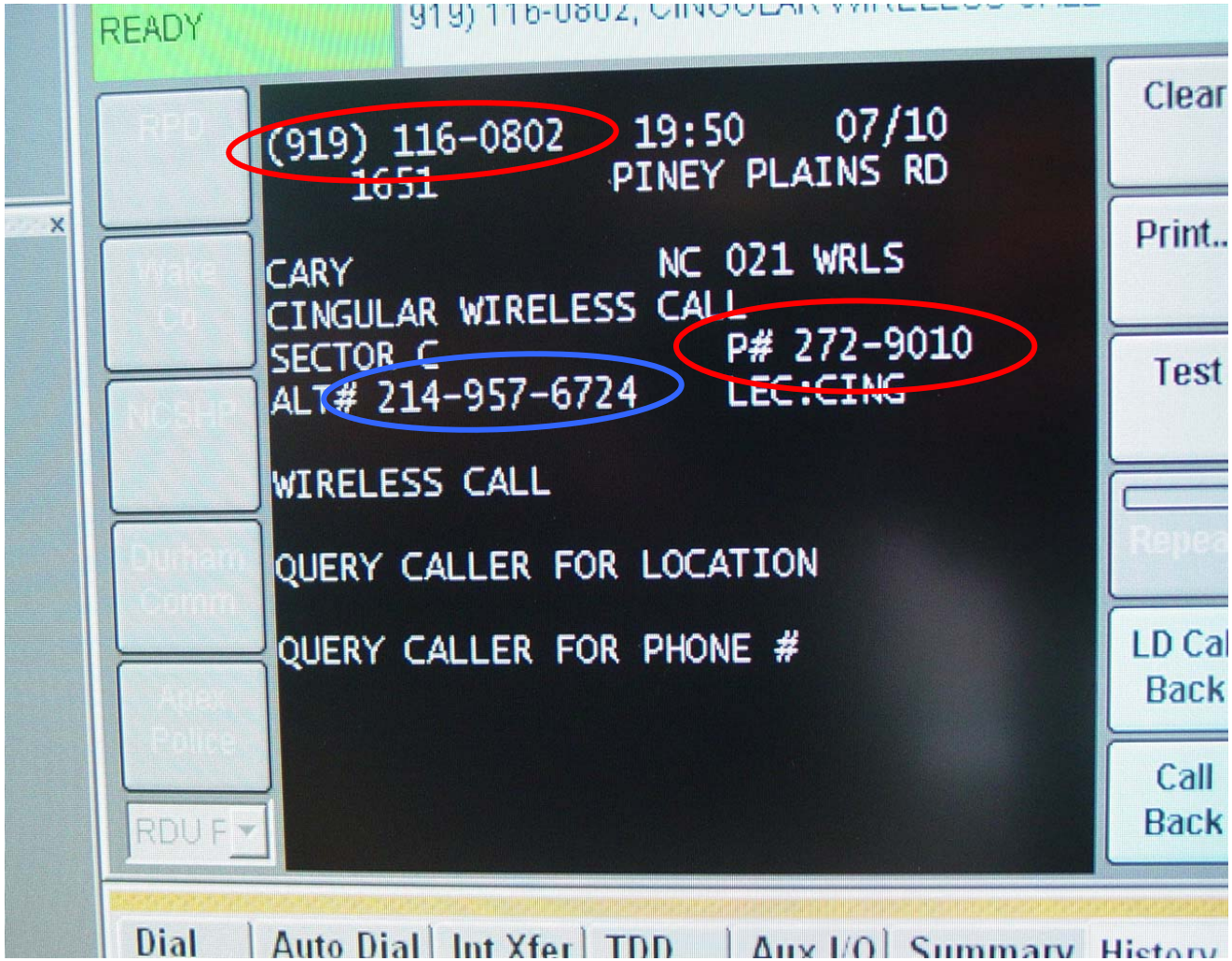
NC AT&T LEC ANI/ALI screen sample: InterAct (NCAS)



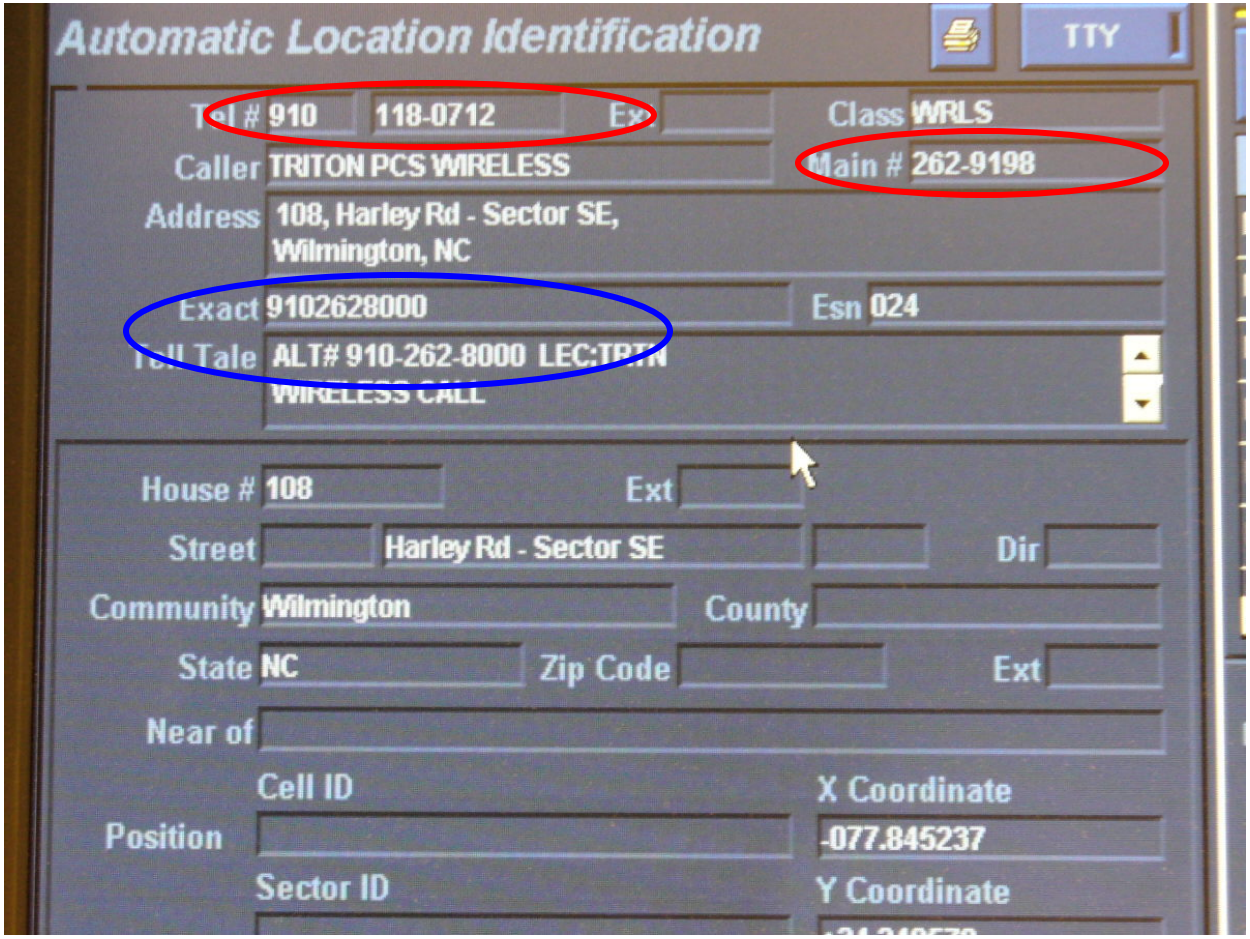
NC AT&T LEC ANI/ALI screen sample: Positron Power911 (NCAS)



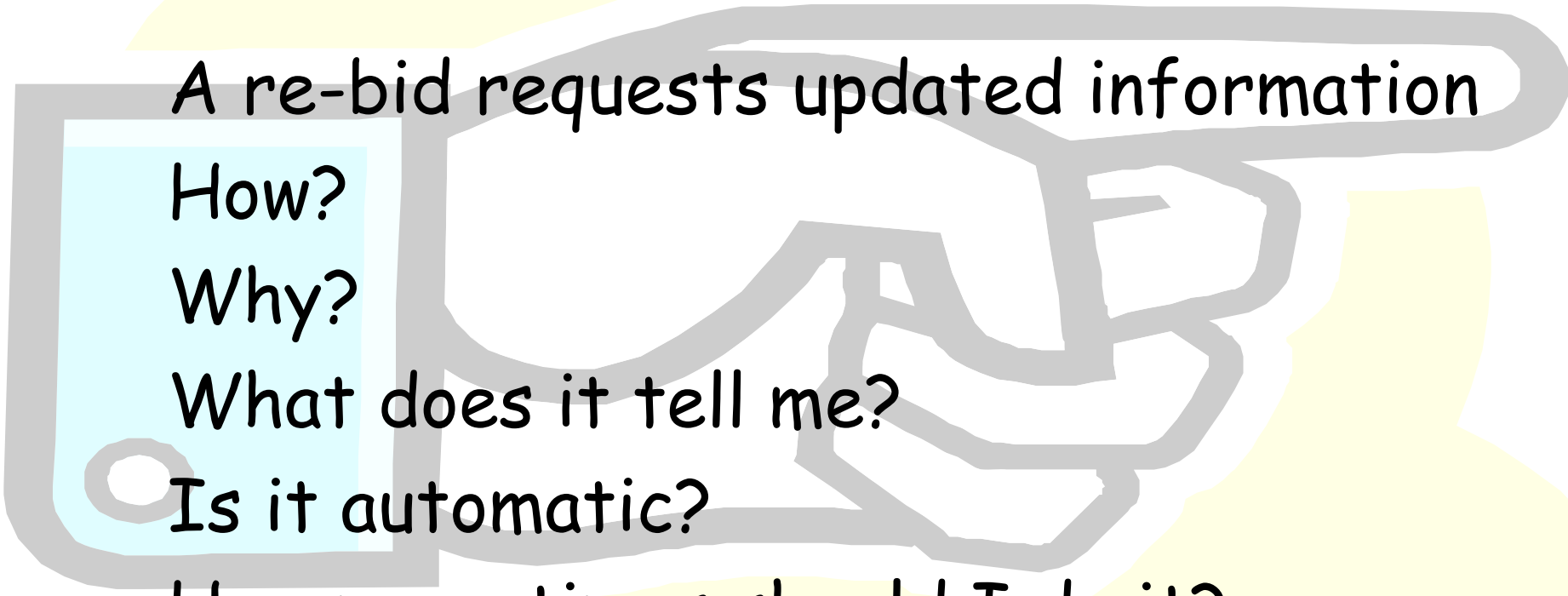
NC AT&T LEC ANI/ALI screen sample: InterAct (CAS)



NC AT&T LEC ANI/ALI screen sample: Positron Power911 (CAS)



What's a re-bid?



A re-bid requests updated information

How?

Why?

What does it tell me?

Is it automatic?

How many times should I do it?

Wireless Classes of Service

The Class of Service field in a wireless 911 call ALI screen indicates what location information you are receiving and depends upon the LEC providing service

MOBL (Embarq) or CELL (Verizon)
WRLS (Embarq, AT&T, Verizon)
WPH1 (Embarq)
WPH2 (Embarq, AT&T, Verizon)

HELPFUL ACCURACY TOOLS
(NOT AVAILABLE IN AT&T LEC SERVICE AREAS)

UNC (Embarq) or COF (Verizon)

ZUNC (Embarq) or ELV (Verizon)

CF (Embarq) or COP (Verizon)

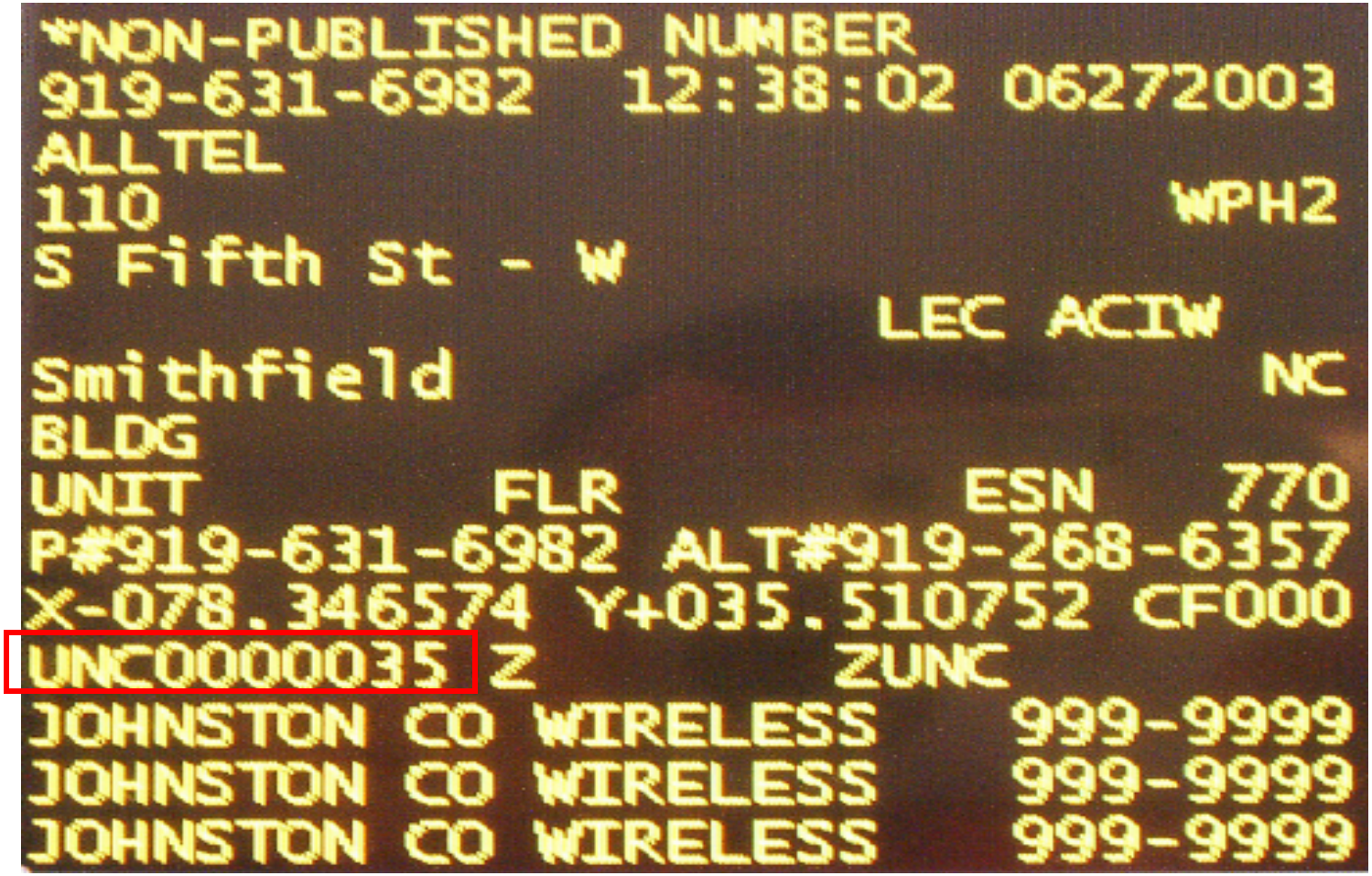
Uncertainty Factor (UNC or COF)

UNC (or COF) is the radius in horizontal meters within which the lat/lon coordinates provided in the ALI are accurate

Currently no Federal mandate

Not passed in AT&T LEC served areas

NC Embarq LEC ALI screen sample: Positron Simon



Altitude (Elevation) Uncertainty Factor (ZUNC or ELV)

ZUNC (or ELV) is the radius in vertical meters within which the altitude (elevation) coordinate (z coordinate) is accurate

Currently no Federal mandate

Provided by some carriers using GPS solutions

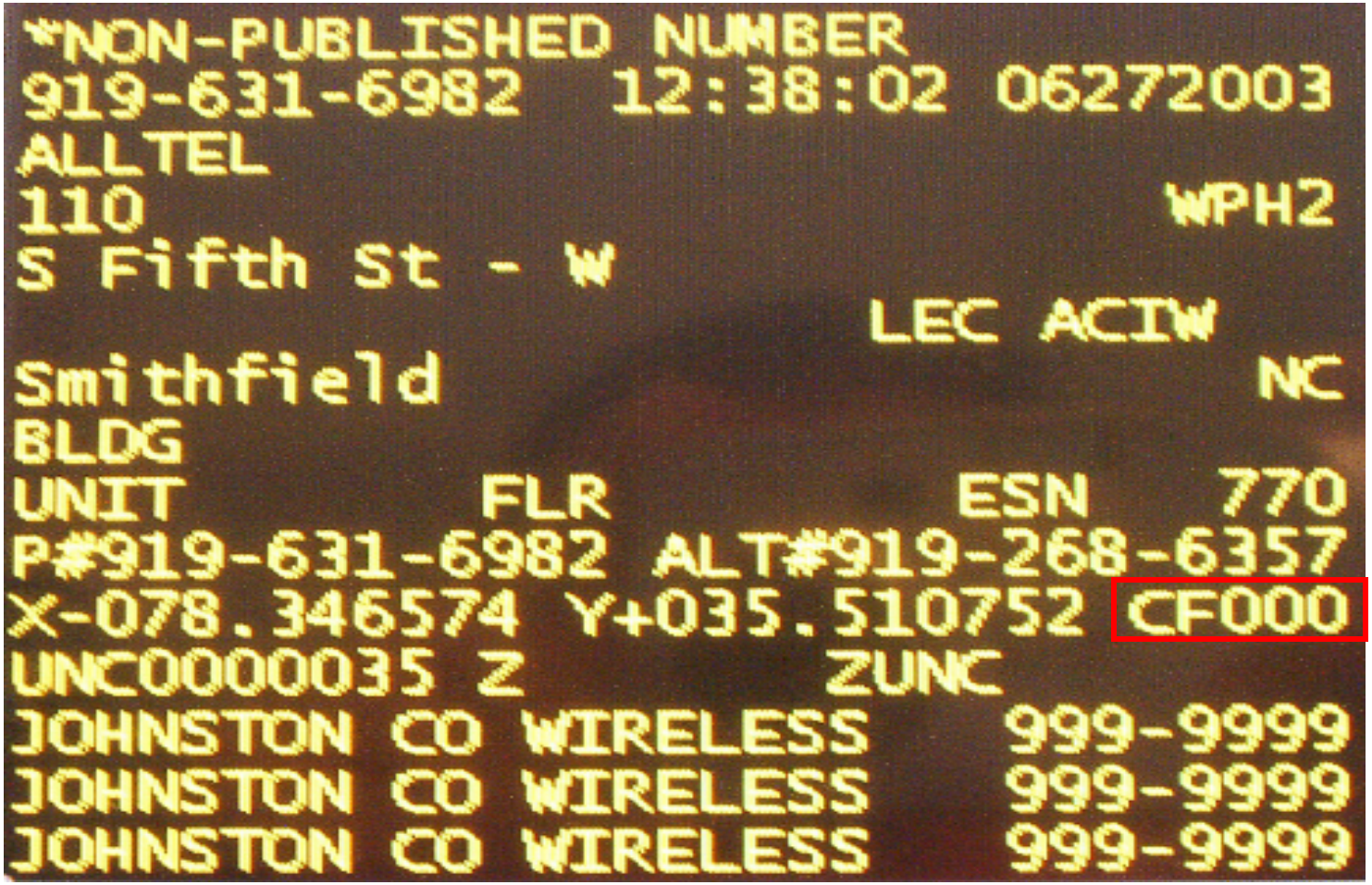
Confidence Factor (CF or COP)

CF (or COP) represents the percentage of confidence the PDE has in the accuracy of the reported location

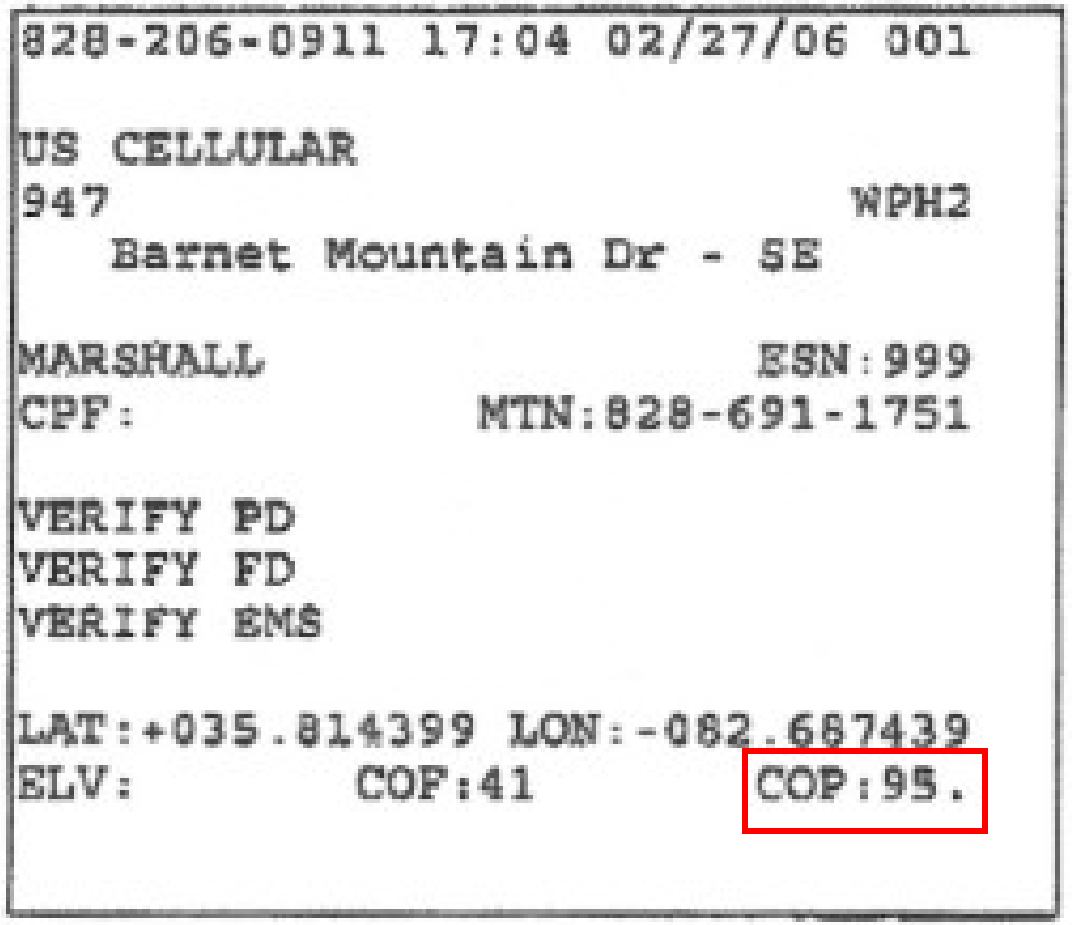
Currently no Federal mandate

CF works in conjunction with the UNC and should never be used without the corresponding UNC

NC Embarq LEC ALI screen sample: Positron Simon



NC Verizon LEC, Madison County Moducom ALI Screen print-out



Location Technology: GPS or Network Based?

94-102 stipulated that Phase 2 longitude and latitude be accurate within stated distances depending upon what location technology a wireless carrier employs:

For handset based (GPS) solutions, accuracy shall be within 50 meters 67% of the time, and 150 meters 95% of the time

For network based solutions, accuracy shall be within 100 meters 67% of the time, and 300 meters 95% of the time

Location Technology: Global Positioning System

GPS location capability is provided by a constellation of 24 satellites orbiting twice a day approximately 12,000 miles above the earth.

The satellites communicate among themselves as well as with land based reference beacons and control centers.

When a signal accesses 4 for or more satellites, they are capable of providing three dimensional position determination, or latitude, longitude, *and* altitude (elevation).

Location Technology: Pros and cons of GPS solution

Pros

- Very accurate with a good satellite fix (3 or more satellites)
- Does not require access to multiple towers

Cons

- Requires line of sight to satellites
- Handsets require GPS chip
- Older phones (legacy phones) without GPS chips *cannot* provide location information

Location Technology: network based

- All calculations are made by land based equipment
- Network solutions rely on triangulation among towers, direction of signal, and time difference of arrival (TDOA)
- Cannot calculate altitude or elevation

Location Technology: Pros and cons of network based solution

Pros

- Can calculate lat/lon very quickly
- Does not require line of sight to satellites
- No GPS chip cost or additional battery drain
- Legacy phones *can* provide location information

Cons

- Needs access to multiple towers to accurately calculate lat/lon
- Towers are frequently lined up along highways, making triangulation difficult
- Less accurate than GPS

Hybrid solution, or A-GPS (Assisted Global Positioning System)

Pros

- Utilizes elements of both GPS and network based systems
- Calculations are made by land based computer systems
- Hybrid GPS chip is less expensive and draws less power than chips used in exclusive GPS solution

Con

- As with exclusive GPS solution, legacy phones without GPS chips still *cannot* provide location information

Who uses what?

In North Carolina:

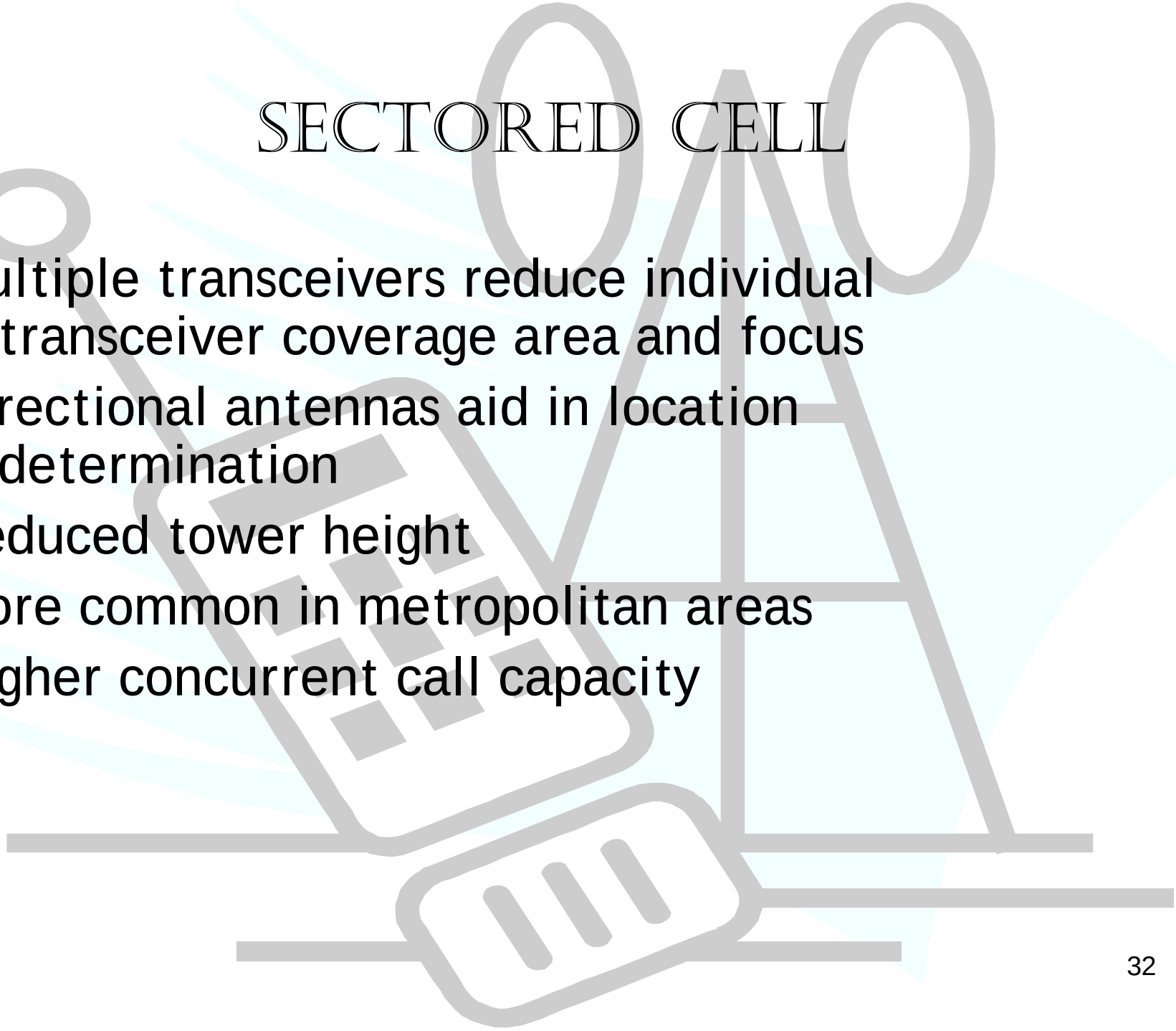
SunCom, AT&T, and T-Mobile use an exclusively network based solution

All other WSPs in NC use an A-GPS based solution

Omnidirectional Cell

- Single transceiver is centered in a circular coverage area
- Towers are usually very tall
- More common in rural locations
- Coverage area often overlaps PSAP boundaries
- Limited to fewer concurrent calls than multi-sectored towers

SECTORED CELL



- Multiple transceivers reduce individual transceiver coverage area and focus
- Directional antennas aid in location determination
- Reduced tower height
- More common in metropolitan areas
- Higher concurrent call capacity

Tower Propagation Footprint Illustration

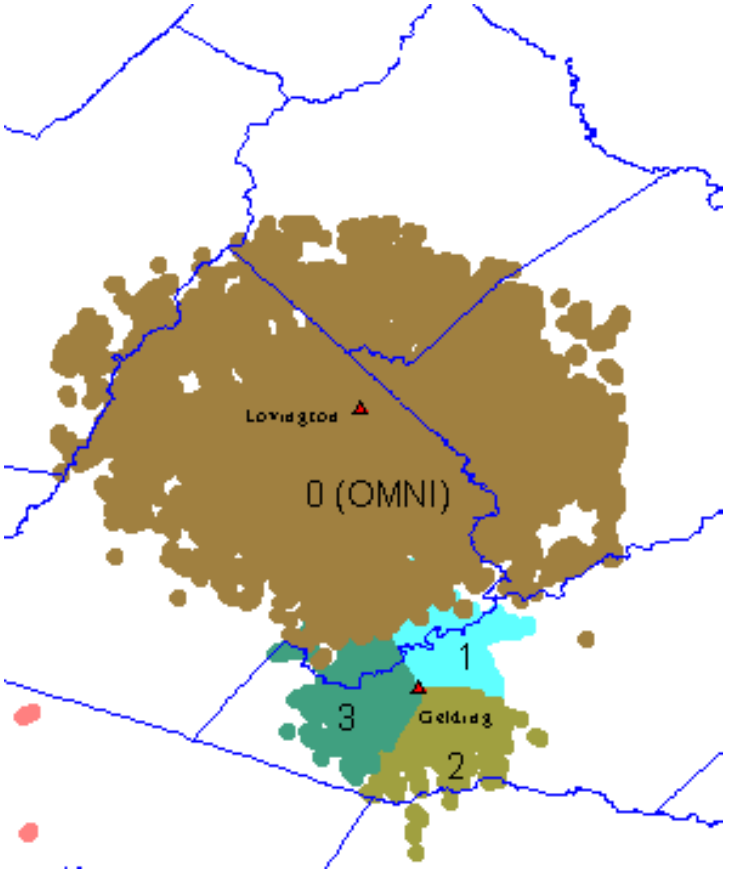
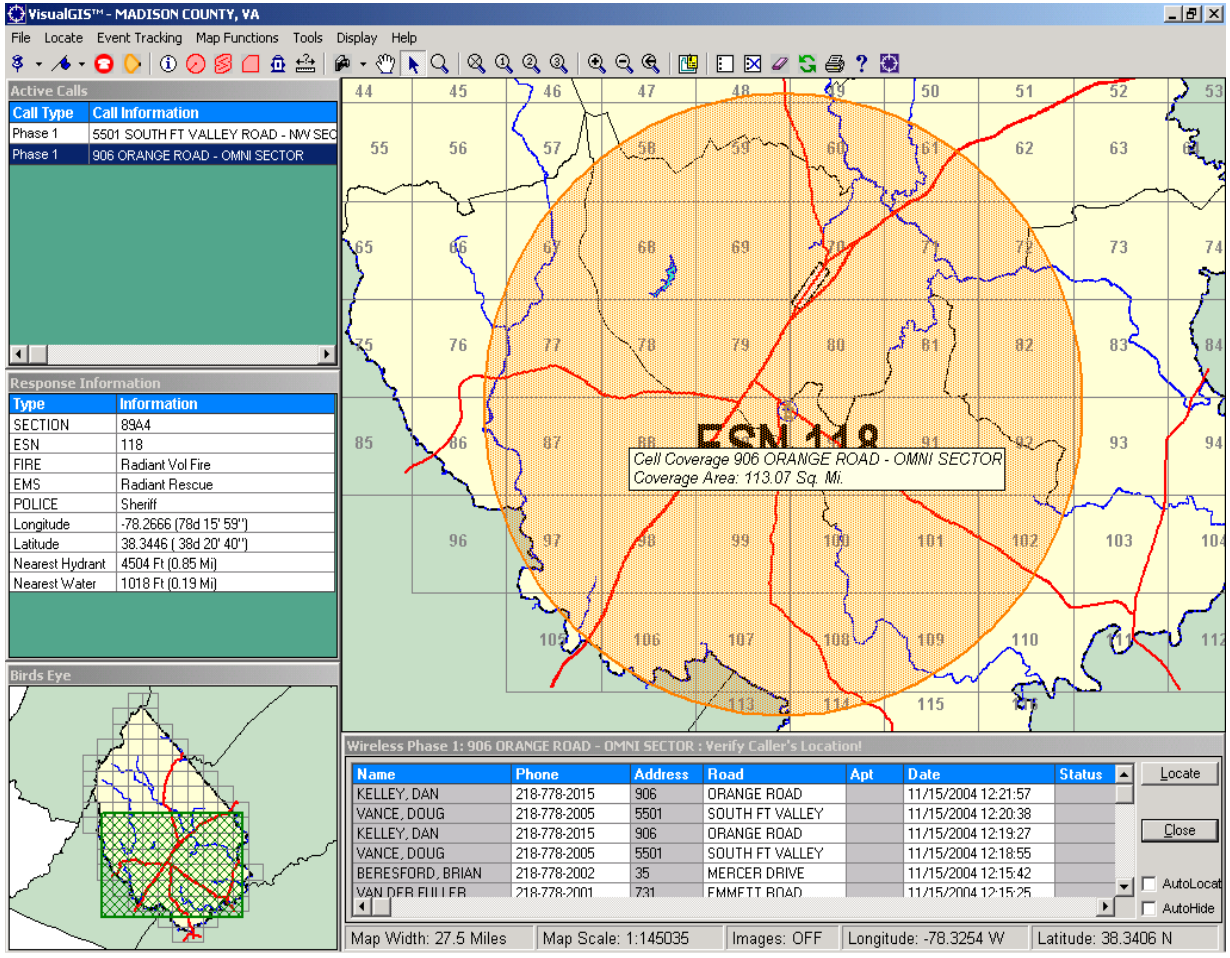


Illustration credit: TCS Document #TCSW008, "E-911 Standard Operating Procedures for PSAPs," Release 10-0, 16 December 2004, p 19, © 2004, All Rights Reserved

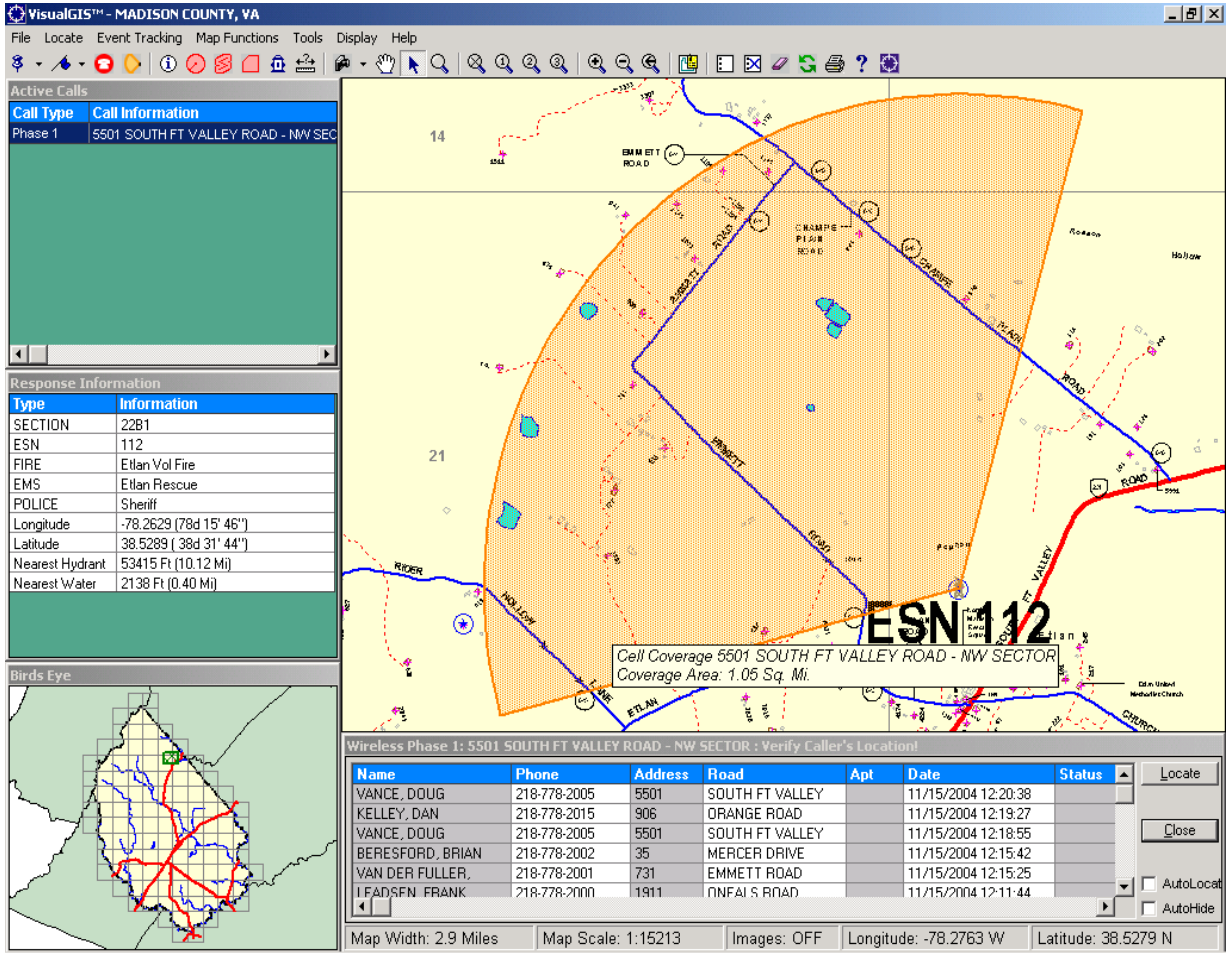
GIS AND PHASE I

Mapping doesn't have to
be just for Phase 2

OMNIDIRECTIONAL PHASE1 CELL COVERAGE AREA MAP SAMPLE: CML MAPPING



CELL SECTOR PHASE1 CELL COVERAGE AREA MAP SAMPLE: CML MAPPING



GIS and Phase 2

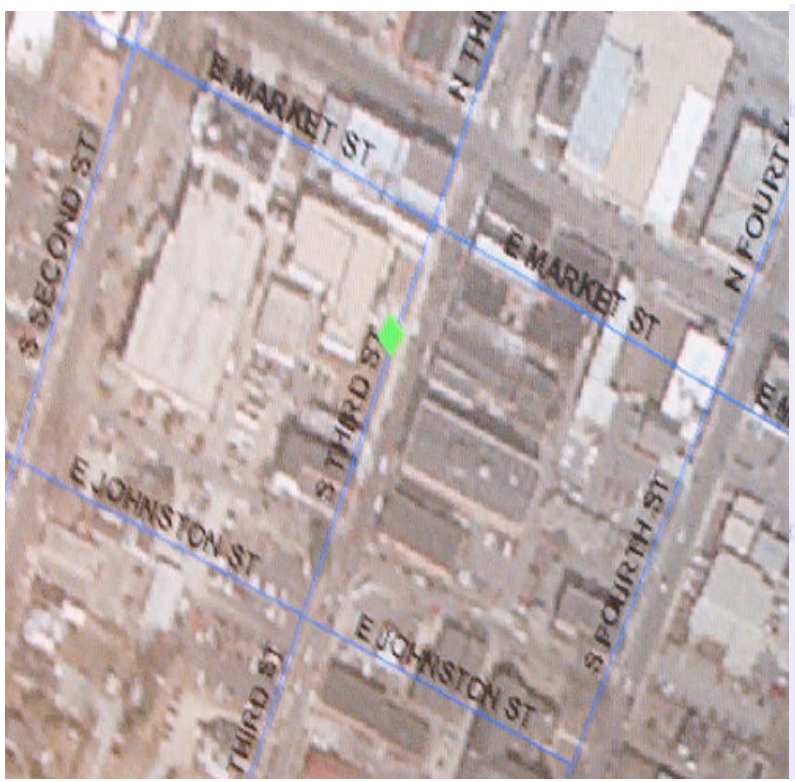
Lat/Lon plot

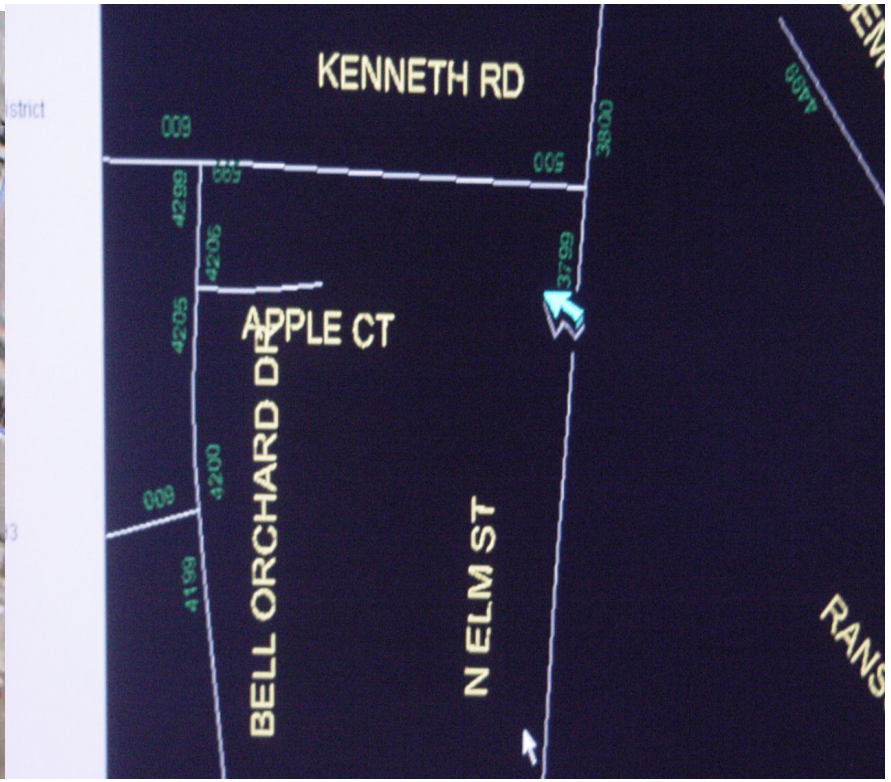
Visual reference

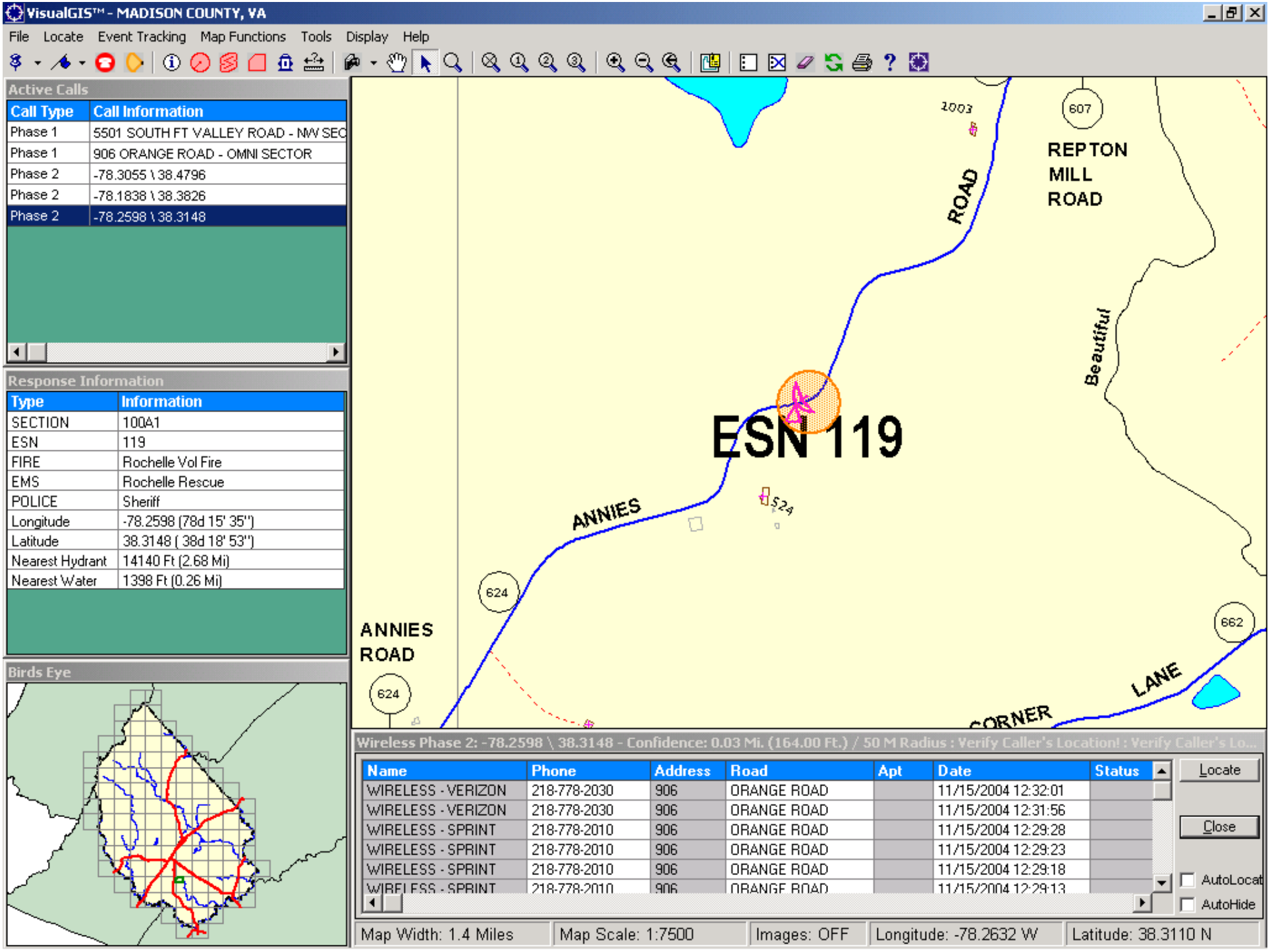
Mid-call location updates

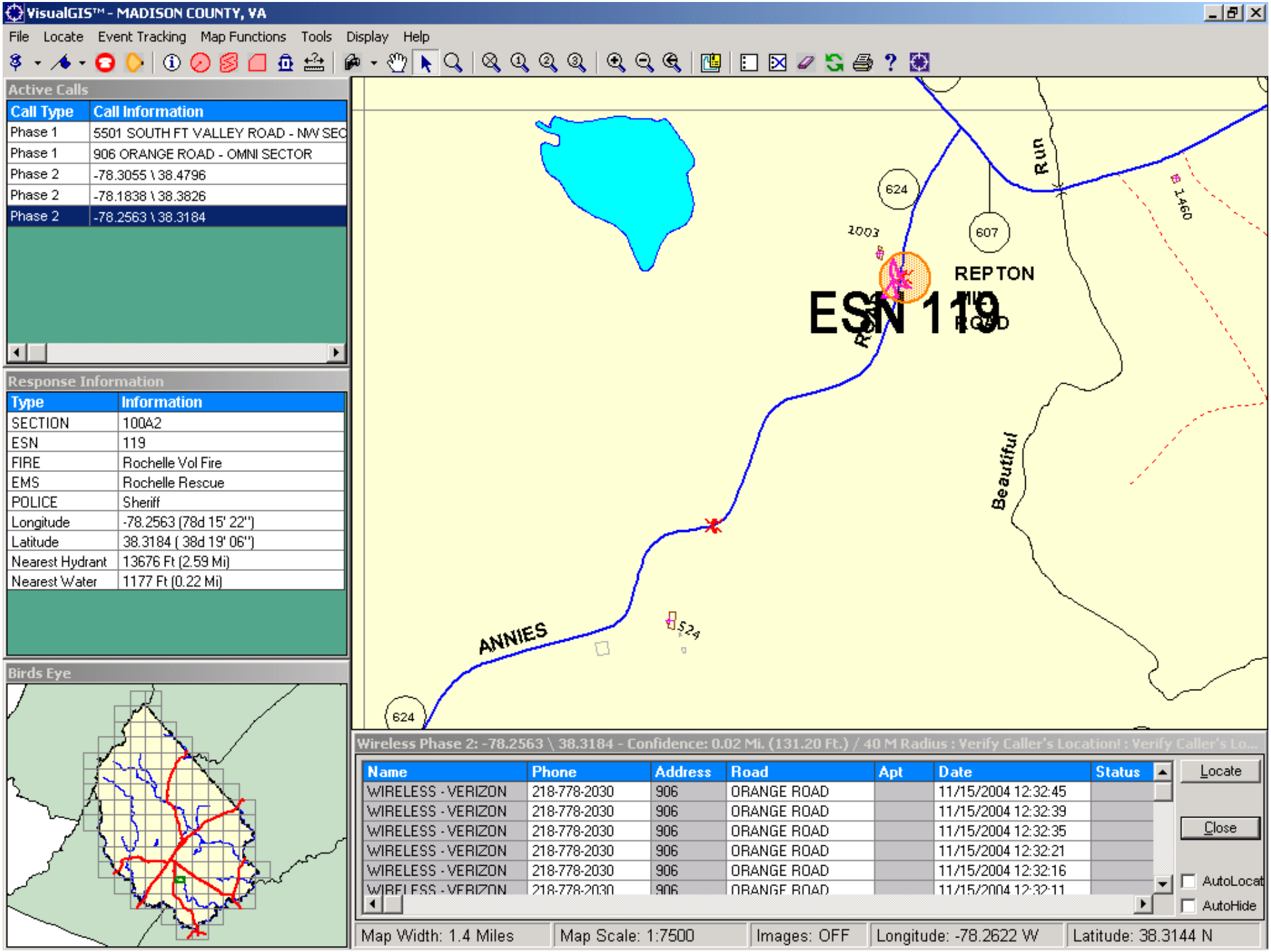
[1] The following series of MCLU slides courtesy of CML

Orthographic and Centerline Map Examples






VisualGIS™ - MADISON COUNTY, VA
File Locate Event Tracking Map Functions Tools Display Help
Active Calls
Call Type | Call Information
Phase 1 | 5501 SOUTH FT VALLEY ROAD - NW SEC
Phase 1 | 906 ORANGE ROAD - OMNI SECTOR
Phase 2 | -78.3055 \ 38.4796
Phase 2 | -78.1838 \ 38.3826
Phase 2 | -78.2598 \ 38.3148
Response Information
Type | Information
SECTION | 100A1
ESN | 119
FIRE | Rochelle Vol Fire
EMS | Rochelle Rescue
POLICE | Sheriff
Longitude | -78.2598 (78d 15' 35")
Latitude | 38.3148 (38d 18' 53")
Nearest Hydrant | 14140 Ft (2.68 Mi)
Nearest Water | 1398 Ft (0.26 Mi)
Birds Eye
ESN 119
REPTON MILL ROAD
ROAD
Beautiful
ANNIES
ANNIES ROAD
LANE
CORNER
607
624
662
524
2003
Wireless Phase 2: -78.2598 \ 38.3148 - Confidence: 0.03 Mi. (164.00 Ft.) / 50 M Radius : Verify Caller's Location! : Verify Caller's Lo...
Name | Phone | Address | Road | Apt | Date | Status
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:32:01
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:31:56
WIRELESS - SPRINT | 218-778-2010 | 906 | ORANGE ROAD | | 11/15/2004 12:29:28
WIRELESS - SPRINT | 218-778-2010 | 906 | ORANGE ROAD | | 11/15/2004 12:29:23
WIRELESS - SPRINT | 218-778-2010 | 906 | ORANGE ROAD | | 11/15/2004 12:29:18
Locate
Close
AutoLocat
AutoHide
Map Width: 1.4 Miles
Map Scale: 1:7500
Images: OFF
Longitude: -78.2632 W
Latitude: 38.3110 N


VisualGIS™ - MADISON COUNTY, VA
File Locate Event Tracking Map Functions Tools Display Help
Active Calls
Call Type | Call Information
Phase 1 | 5501 SOUTH FT VALLEY ROAD - NW SEC
Phase 1 | 906 ORANGE ROAD - OMNI SECTOR
Phase 2 | -78.3055 \ 38.4796
Phase 2 | -78.1838 \ 38.3826
Phase 2 | -78.2563 \ 38.3184
Response Information
Type | Information
SECTION | 100A2
ESN | 119
FIRE | Rochelle Vol Fire
EMS | Rochelle Rescue
POLICE | Sheriff
Longitude | -78.2563 (78d 15' 22")
Latitude | 38.3184 (38d 19' 06")
Nearest Hydrant | 13676 Ft (2.59 Mi)
Nearest Water | 1177 Ft (0.22 Mi)
Birds Eye
ESN 119
REPTON
ROAD
ANNIES
Run
Beautiful
624
607
1003
1460
524
Wireless Phase 2: -78.2563 \ 38.3184 - Confidence: 0.02 Mi. (131.20 Ft.) / 40 M Radius : Verify Caller's Location! : Verify Caller's Lo...
Name | Phone | Address | Road | Apt | Date | Status
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:32:45
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:32:39
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:32:35
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:32:21
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:32:16
Locate
Close
AutoLocat
AutoHide
Map Width: 1.4 Miles
Map Scale: 1:7500
Images: OFF
Longitude: -78.2622 W
Latitude: 38.3144 N

VisualGIS™ - MADISON COUNTY, VA

File Locate Event Tracking Map Functions Tools Display Help

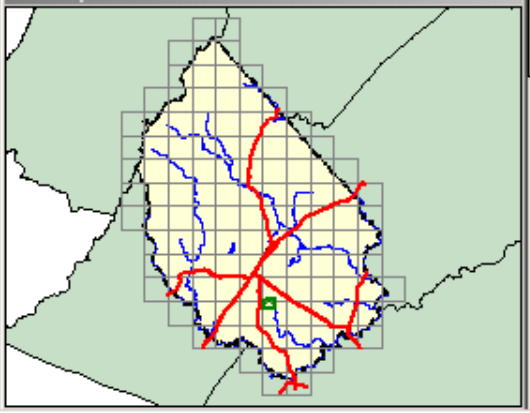
Active Calls

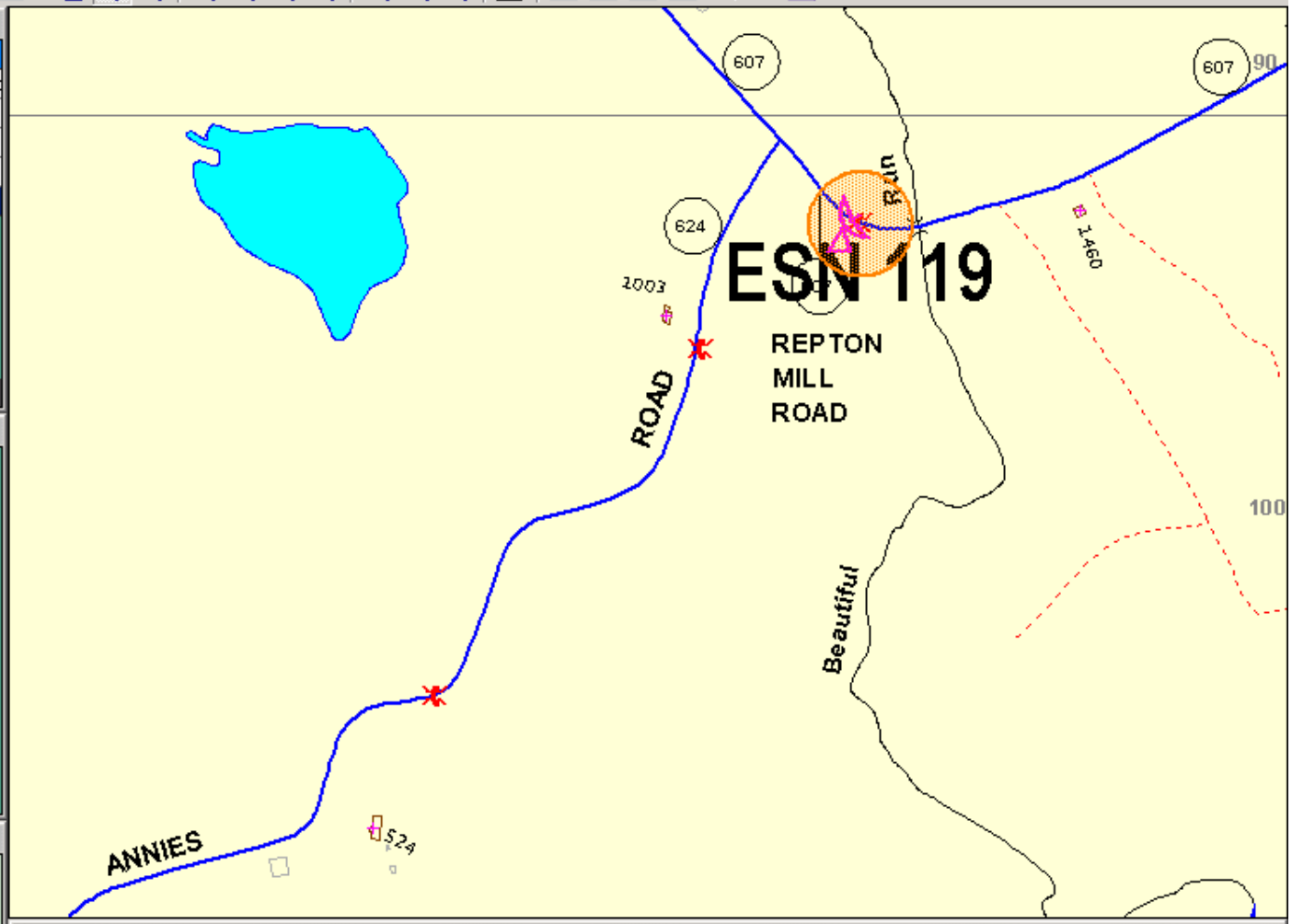
Call Type	Call Information
Phase 1	5501 SOUTH FT VALLEY ROAD - NW SEC
Phase 1	906 ORANGE ROAD - OMNI SECTOR
Phase 2	-78.3055 \ 38.4796
Phase 2	-78.1838 \ 38.3826
Phase 2	-78.2542 \ 38.3197

Response Information

Type	Information
SECTION	100A2
ESN	119
FIRE	Rochelle Vol Fire
EMS	Rochelle Rescue
POLICE	Sheriff
Longitude	-78.2542 (78d 15' 15")
Latitude	38.3197 (38d 19' 10")
Nearest Hydrant	13716 Ft (2.60 Mi)
Nearest Water	1718 Ft (0.33 Mi)

Birds Eye





Wireless Phase 2: -78.2542 \ 38.3197 - Confidence: 0.04 Mi. (196.80 Ft.) / 60 M Radius : Verify Caller's Location! : Verify Caller's Lo...

Name	Phone	Address	Road	Apt	Date	Status
WIRELESS - VERIZON	218-778-2030	906	ORANGE ROAD		11/15/2004 12:32:50	
WIRELESS - VERIZON	218-778-2030	906	ORANGE ROAD		11/15/2004 12:32:45	
WIRELESS - VERIZON	218-778-2030	906	ORANGE ROAD		11/15/2004 12:32:39	
WIRELESS - VERIZON	218-778-2030	906	ORANGE ROAD		11/15/2004 12:32:35	
WIRELESS - VERIZON	218-778-2030	906	ORANGE ROAD		11/15/2004 12:32:21	
WIRELESS - VERIZON	218-778-2030	906	ORANGE ROAD		11/15/2004 12:32:16	

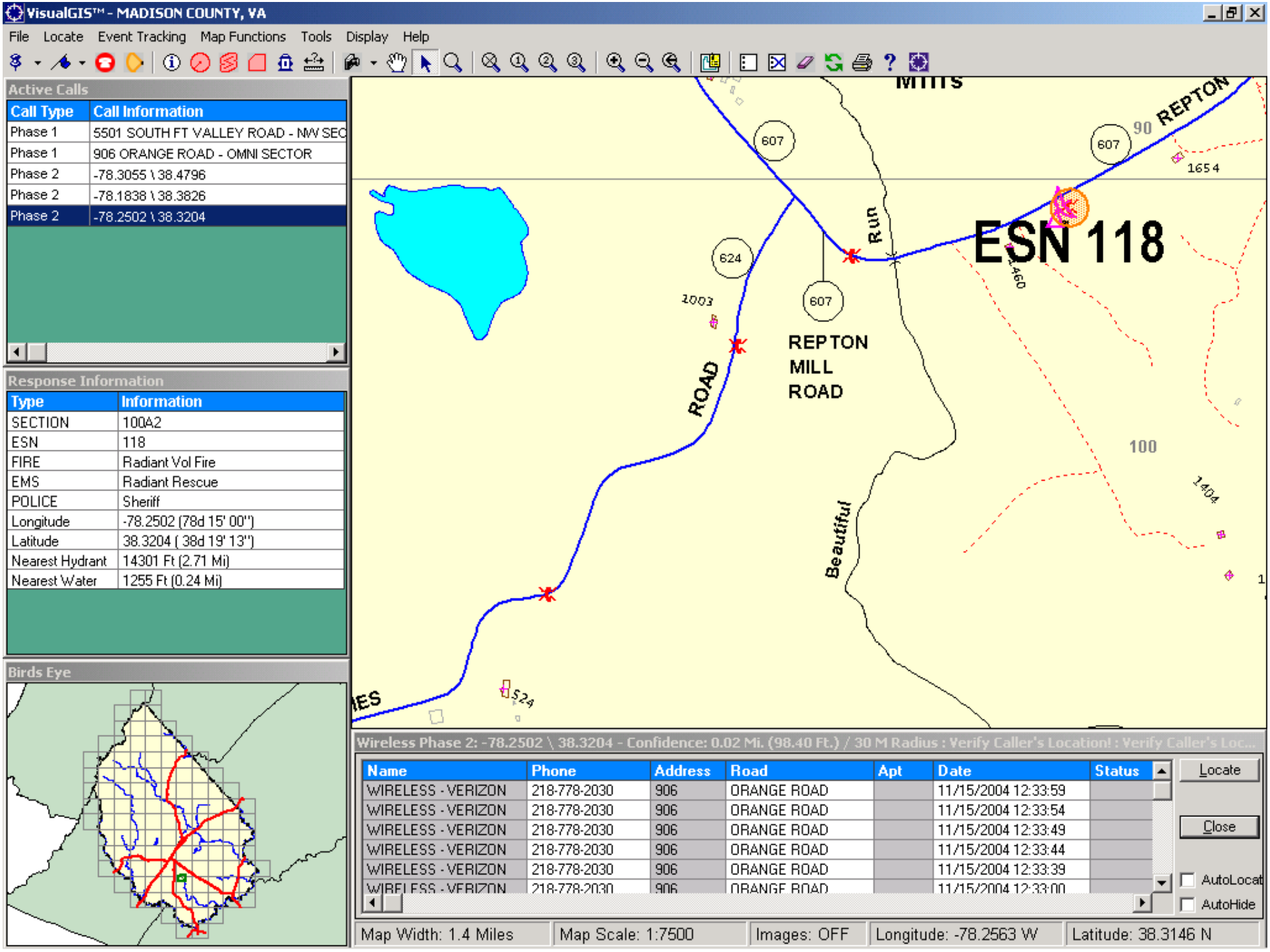
Locate

Close

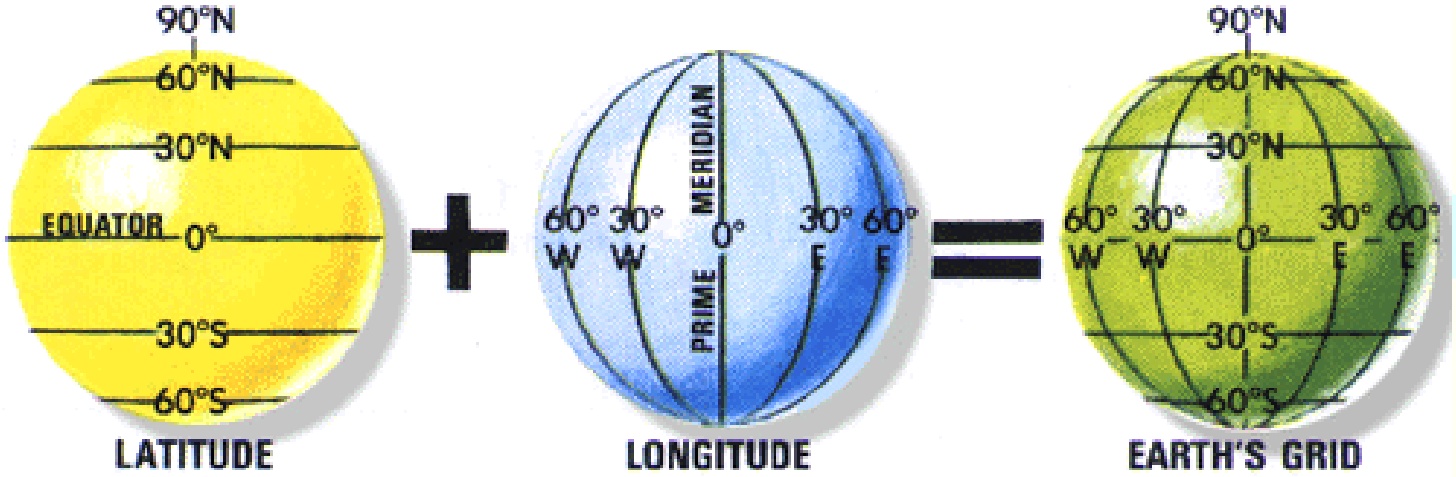
AutoLocat

AutoHide

Map Width: 1.4 Miles | Map Scale: 1:7500 | Images: OFF | Longitude: -78.2590 W | Latitude: 38.3137 N


VisualGIS™ - MADISON COUNTY, VA
File Locate Event Tracking Map Functions Tools Display Help
Active Calls
Call Type | Call Information
Phase 1 | 5501 SOUTH FT VALLEY ROAD - NW SEC
Phase 1 | 906 ORANGE ROAD - OMNI SECTOR
Phase 2 | -78.3055 \ 38.4796
Phase 2 | -78.1838 \ 38.3826
Phase 2 | -78.2502 \ 38.3204
Response Information
Type | Information
SECTION | 100A2
ESN | 118
FIRE | Radiant Vol Fire
EMS | Radiant Rescue
POLICE | Sheriff
Longitude | -78.2502 (78d 15' 00")
Latitude | 38.3204 (38d 19' 13")
Nearest Hydrant | 14301 Ft (2.71 Mi)
Nearest Water | 1255 Ft (0.24 Mi)
Birds Eye
ESN 118
REPTON
MILL
ROAD
ROAD
Run
Beautiful
607
624
100
Wireless Phase 2: -78.2502 \ 38.3204 - Confidence: 0.02 Mi. (98.40 Ft.) / 30 M Radius : Verify Caller's Location! : Verify Caller's Loc...
Name | Phone | Address | Road | Apt | Date | Status
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:33:59
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:33:54
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:33:49
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:33:44
WIRELESS - VERIZON | 218-778-2030 | 906 | ORANGE ROAD | | 11/15/2004 12:33:39
Locate
Close
AutoLocat
AutoHide
Map Width: 1.4 Miles
Map Scale: 1:7500
Images: OFF
Longitude: -78.2563 W
Latitude: 38.3146 N

LATITUDE & LONGITUDE



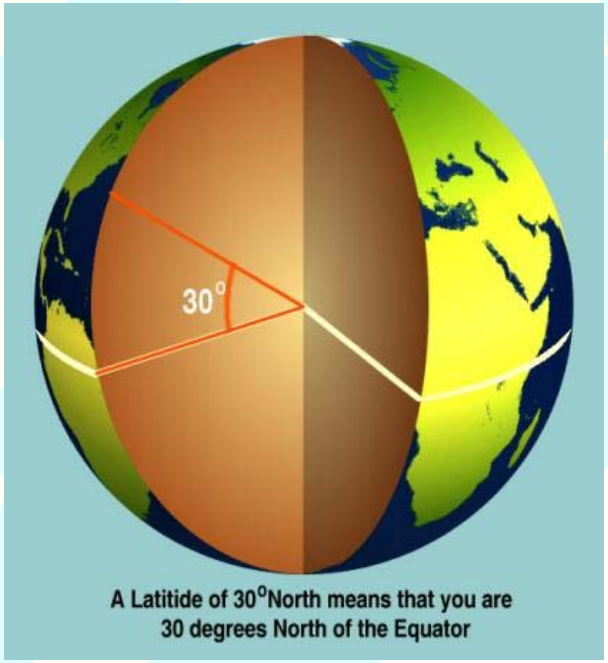
Units of measurement are degrees, minutes, and seconds, but ALI values are expressed in decimal degrees

LATITUDE

Lines of latitude (where the y coordinate is plotted) run east and west (horizontally) along the surface of the earth and reference a distance from the equator determined by the angle created between that point, the center of the earth, and the equator.

The equator, which is the baseline for all latitude values, is an imaginary line circling the earth midway between the north and south poles.

Every degree of latitude north of the equator is in the positive (+) range and every degree of latitude south of the equator is in the negative (-) range.



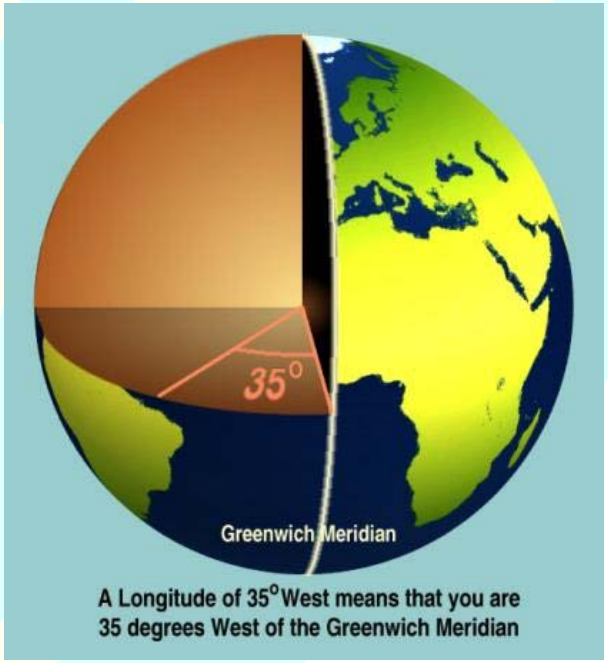
A Latitide of 30°North means that you are 30 degrees North of the Equator

LONGITUDE

Lines of longitude (where the x coordinate is plotted) run north and south (vertically) along the surface of the earth and reference a distance from the Prime Meridian determined by the angle formed between that point, the center of the earth, and the Prime Meridian.

The Prime Meridian, which is the 'base line' for all longitude values, is an imaginary reference line connecting the north and south poles and passing through Greenwich, England.

The International Dateline is a continuation of the arc described by the Prime Meridian on the 'back side' of the earth, representing a neutral (neither positive nor negative) longitude value of 180 degrees.



A notation note

Often the phrase “lat/lon (long)" or “x/y” is used to describe an intersection point on the earth coordinate grid. This causes some confusion because “lat" is **not** the x coordinate and “lon" is **not** the y coordinate. It is actually just the reverse! If you say "lat/lon" you are really saying “y/x“, and vice versa.

KEY ELEMENTS TO REMEMBER

Always pay close attention to the CLAS.

If the CLAS is **NOT** WPH2 and lat/lon is presented, it does **NOT** represent the caller's location.

Don't stop re-bidding until either your lat/lon coordinates (and/or your GIS plots) change only insignificantly between re-bids, or your UNC and CF report high certainty and confidence values.

Non-service initialized (NSI) phones

94-102 stipulates that any wireless phone, initialized or not, must be capable of calling 911, provided, of course, it has a power source.

Phones that are not under an active service agreement, whether contract or prepaid, have no usable phone number or wireless provider associated with them.

When such phones call 911, telecommunicators may see any one of a variety of number combinations where the MDN should be.

If the call is coming from a network solution provider, you may receive lat/lon coordinates, regardless of whether or not the phone is initialized.

Non-service initialized (NSI) phone clues

One scenario presents the last phone number associated with the handset when it was initialized as the callback number

Another scenario presents a string of zeroes

Yet a third scenario presents a sequential string of numbers such as 1234567890

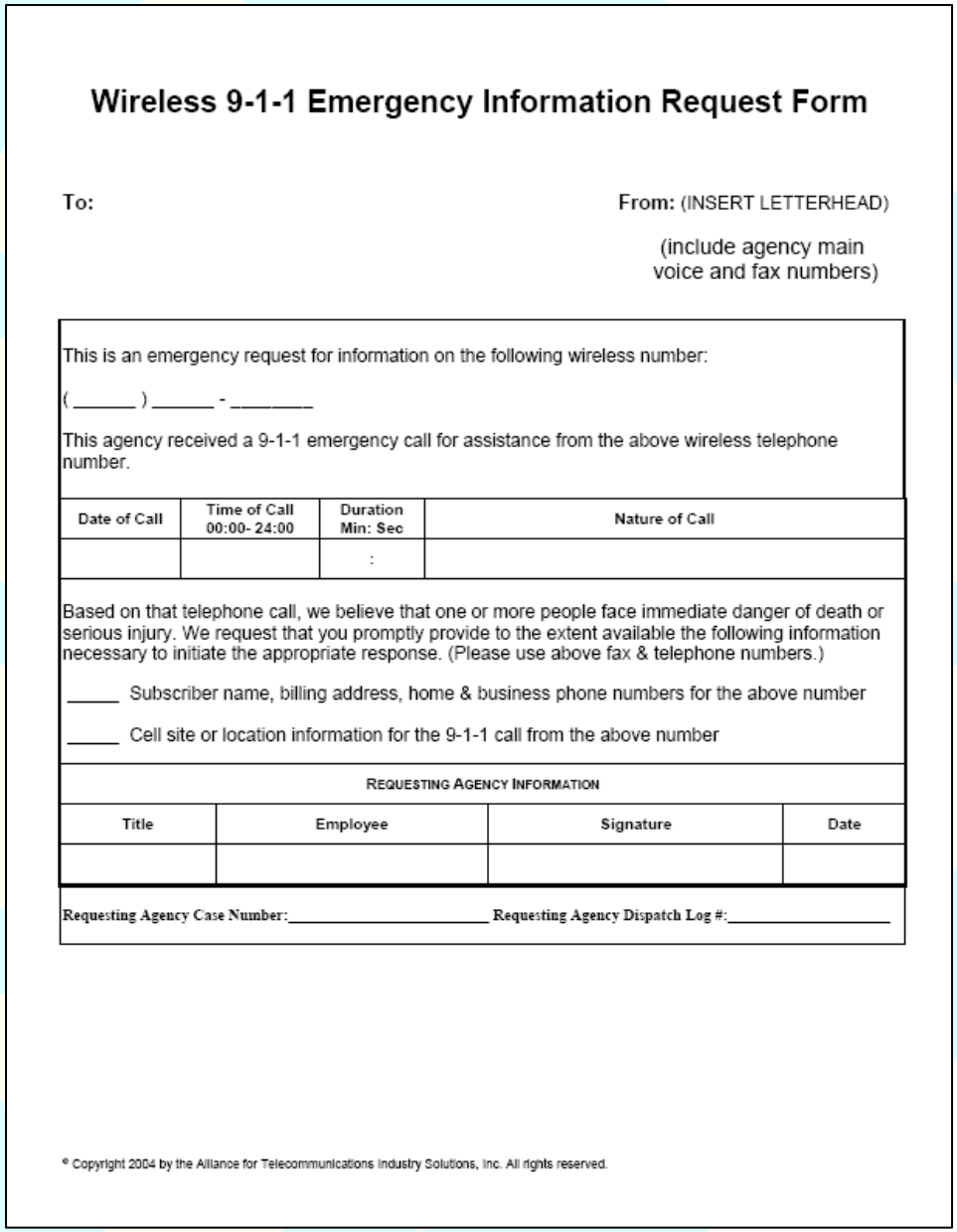
A fourth possibility is the number 911 in the NPA (area code) field followed by the last seven digits of the handset's electronic serial number in the nxx-xxxx fields

Exigent Circumsances Requests

Request subscriber information

Some forms are proprietary

ESIF form (Word) found at http://www.atis.org/esif/docs.asp



Wireless 9-1-1 Emergency Information Request Form

To:

From: (INSERT LETTERHEAD)

(include agency main voice and fax numbers)

This is an emergency request for information on the following wireless number:

(_____) _____ - _____

This agency received a 9-1-1 emergency call for assistance from the above wireless telephone number.

Date of Call	Time of Call 00:00- 24:00	Duration Min: Sec	Nature of Call
		:	

Based on that telephone call, we believe that one or more people face immediate danger of death or serious injury. We request that you promptly provide to the extent available the following information necessary to initiate the appropriate response. (Please use above fax & telephone numbers.)

_____ Subscriber name, billing address, home & business phone numbers for the above number

_____ Cell site or location information for the 9-1-1 call from the above number

REQUESTING AGENCY INFORMATION

Title	Employee	Signature	Date

Requesting Agency Case Number:_____ Requesting Agency Dispatch Log #:_____

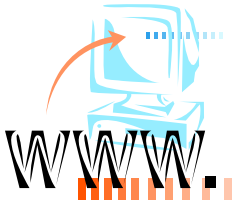
Speaking of identifying: Tracking it down

Know IN ADVANCE how to contact the WSP's subpoena compliance center

Know what they require of you before they will give you information

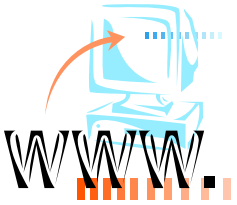
Prank calls from uninitialized phones CAN be stopped

A list of 24/7 contact numbers is available at *http://www.nena.org/companyid/cid.asp*



WHAT ELSE?

VoIP



- Sometimes on administrative lines
  - Voice mail?
  - Unenhanced 911 (translation) line?
- Sometimes on 911 trunks
- VoIP class of service
- ALI updates dependent upon customer entered information

What else?
Telematics & ACN

- **Automatic Collision Notification**
- **Presently voice-only from call center to 911 center in many areas**
- **New OnStar initiative to access 911 network utilizing VoIP based access in some areas**
- **Much potentially useful data available**

WHAT ELSE?

Next generation 911 (NG911)

- Current 911 phone network is antiquated
- New communication methods & devices are used by public
- Internet Protocol network is critical
- Voice AND data will be available to 911 tcs

WHAT ELSE?

Drive Testing

Necessary

Important

Cooperative effort

Internet Resources

NC 911 Board

www.nc911.net

National Emergency Number Association (NENA)

www.nena.org

Association of Public-Safety Communications Officials (APCO)

www.apcointl.org

National Association of State 911 Administrators (NASNA)

www.nasna911.org

Cellular Telecommunications Industry Association (CTIA)

www.ctia.org

Federal Communications Commission (FCC)

www.fcc.gov

Internet Resources (cont)

E-mail address to join the NCAPCO/NENA listserv:

ncapconena-subscribe@yahoogroups.com

to unsubscribe, simply send an e-mail to

ncapconena-unsubscribe@yahoogroups.com